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# VERTEBRATE ANIMALS
# OF THE
# UNITED STATES
(Exclusive of Birds)

PRATT

A MANUAL OF
LAND AND FRESH WATER

# VERTEBRATE ANIMALS
OF THE
# UNITED STATES
(Exclusive of Birds)

BY

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WITH 184 ILLUSTRATIONS

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TO THE MEMORY OF

ISAAC SHARPLESS

(President of Haverford College 1887–1917)

a Lover of Nature and a Good Man

# PREFACE

This Manual has been written to furnish students of Zoology, students of the Geographical Distribution of animals, and Nature students, with diagnostic descriptions of the land and fresh water vertebrate animals of the United States, together with analytical keys by means of which they can be readily identified and their affinities determined. Many excellent hand-books for the identification of birds already exist, and their number is constantly being added to, and it is for this reason that this large Class has not been included in the present book. There is, however, a very real need of a general modern manual of the fishes, amphibians, reptiles and mammals of the country which shall give the accepted scientific names of species, as well as of the larger groups to which they belong, and also reflect the recent advances in our knowledge of their systematic and structural relationships, their manner of life and their geographical distribution.

The region covered by this work is the whole of the United States between the Canadian and Mexican borders, neither Alaska nor the West Indian or Hawaiian Islands being included; the southern portion of Canada, however, is included, as it belongs to the same geographical region as the northern portion of the United States. With certain exceptions, all the species, as well as the geographic subspecies, of the four Classes of vertebrates above mentioned which are found in this large region, are described, the exceptions being those species which are of doubtful validity, those which are very rare, and certain Mexican species, chiefly of reptiles, which have been observed but a few times north of the boundary. Great care has been taken to state precisely the geographic limits of these species and subspecies.

In compiling this work the author has utilized every source of information at his command, and is consequently under obligations to very many persons; to all of these he extends his heartiest thanks. The section on Fishes is based upon Jordan and Evermann's "Fishes of North and Middle America," and one of the authors of this fundamental work, Dr. Barton Warren Evermann, Director of the Museum of the California Academy of Sciences, San Francisco, has read this portion of the manuscript critically. Large use has also been made of "American Food and Game Fishes" by the same authors, and of Jor-

dan's "Guide to the Study of Fishes" and "Manual of Vertebrates," and also of Forbes and Richardson's "Fishes of Illinois," the general arrangement of the main subdivisions of the Class being based on the last-named work. Smith's "Fishes of North Carolina," Bean's "Fishes of New York," and the various papers in the Bulletins of the Fish Commission and the Bureau of Fisheries, as well as numerous other publications, have also been used. In the arrangement of the Lampreys the recent revision of Creaser and Hubbs published by the Museum of Zoology of the University of Michigan has been followed.

The arrangement of the Amphibians and Reptiles has been based upon Stejneger and Barbour's "Check List of North American Amphibians and Reptiles" and the descriptions and keys upon Cope's "Batrachia of North America" and Cope's "Crocodilians, Lizards and Snakes of North America." Extensive use has also been made of many other works, especially Miss Dickerson's "Frog Book," Ditmar's "Reptile Book," and the State Reports of several States. The author is under an especial obligation to the important Smith college group of Herpetologists for bringing his arrangement and descriptions down to date, the morphological studies of Professor H. H. Wilder and Professor I. W. Wilder and the systematic studies of Professor E. R. Dunn having contributed to this end. The latter author, especially, has revised the sections on the caudate Amphibians and the Snakes and Turtles, the synopsis of the larvæ of the Plethodontidæ, which is largely new matter, being wholly by him. Dr. G. Kingsley Noble of the American Museum of Natural History, New York, has revised the section on Frogs and Toads, and Karl P. Schmidt of the Field Columbian Museum, Chicago, that on Lizards and Crocodilians. The synopsis of the eggs and larvæ of Frogs and Toads has been taken from A. H. Wright's "Life History of the Anura of Ithaca, New York."

The arrangement of the Mammals is based upon Garret S. Miller, Jr.'s "List of the North American Land Mammals in the United States National Museum, 1911." For the description and keys full use has been made of the various numbers of "The North American Fauna" prepared under the direction of C. Hart Merriam, former Director of the United States Biological Survey, the publication of which has been of epochal importance in the study of American mammals. Many other works have been useful, especially Elliot's "Synopsis of the Mammals of North America and adjacent Seas," which is a work of fundamental importance. For accounts of the life and habits of mammals, Stone and Cram's "American Animals," Nelson's "Wild Animals," Seton's "Northern Animals," and Audubon and Bachman's

"Quadrupeds of North America" have been used. The senior author of the first named work, Dr. Witmer Stone, of the Academy of Natural Sciences, Philadelphia, has been so good as to read critically the whole manuscript of Mammals.

The figures which have been introduced are intended to illustrate and explain the most important diagnostic features of the various groups of animals and to illuminate the keys and make them more easy to comprehend, and have been copied mostly from monographs, special treatises and textbooks; the author here extends his thanks to the authors of these figures and the publishers of the books in which they are found for the privilege of using them.

In the use of scientific names of animals the laws of priority established by the International Commission of Nomenclature have been followed. The name of the author of each species, subspecies and genus follows the first mention of it in the descriptions, as is customary, and in those cases in which an author originally placed his species in some other genus than the one here given, his name is in parentheses. Wherever an author's name appears more than once in the same genus it is usually abbreviated after the first occurrence. No other abbreviations of the names of authors' appear except in the case of Linnæus, whose name is always shortened to "L" wherever he appears as the author of a scientific name.

Much of the labor of compiling this work has been done at Cold Spring Harbor, Long Island, and the author wishes to express his great obligation to his friend and colleague, Dr. Charles B. Davenport, for his constant support and encouragement during its progress. He also wishes to thank his publishers, P. Blakiston's Son and Company, for their many courtesies and their readiness in meeting his wishes.

Haverford College
Haverford, Pa.

# CONTENTS


PAGE

THE VERTEBRATES . . . 1
External characters . . . 1
Internal characters . . . 4
Distribution . . . 10
History . . . 12
Classification . . . 13
Key to the classification of vertebrates . . . 14
CLASS 1. FISHES . . . 15
Number of species and distribution . . . 15
History . . . 15
On the identification of fishes . . . 16
Key to the subclasses of fishes . . . 24
Subclass 1. Marsipobranchii . . . 24
Order 1. Hyperotreti . . . 24
Order 2. Hyperoartii . . . 24
Family Petromyzonidæ . . . 25
Subclass 2. Pisces . . . 27
Division 1. Selachii . . . 28
Division 2. Dipnoi . . . 28
Division 3. Teleostomi . . . 28
Series 1. Ganoidea . . . 28
Order 1. Crossopterygii . . . 29
Order 2. Chondrostei . . . 29
Family 1. Polyodontidæ . . . 29
Family 2. Acipenseridæ (Sturgeons) . . . 29
Order 3. Holostei . . . 31
Family 1. Lepisosteidæ (Garpikes) . . . 32
Family 2. Amiidæ (Bowfins) . . . 32
Series 2. Teleostei . . . 33
Key to the orders of Teleostei . . . 33
Order 1. Isospondyli . . . 34
Family 1. Hiodontidæ (Mooneyes) . . . 34
Family 2. Dorosomidæ (Gizzard shad) . . . 35
Family 3. Clupeidæ (Herring; shad) . . . 36
Family 4. Salmonidæ . . . 37
Subfamily 1. Coregoninæ (Whitefish) . . . 37
Subfamily 2. Salmoninæ (Salmon; trout) . . . 42
Family 5. Thymallidæ (Graylings) . . . 49
Family 6. Argentinidæ (Smelt) . . . 50
Order 2. Apodes . . . 50
Family Anguillidæ (Eels) . . . 51
Order 3. Eventognathi . . . 51
Family 1. Catostomidæ (Suckers; mullet; redhorse) . . . 51
Family 2. Cyprinidæ (Minnows; carp) . . . 61
Order 4. Heterognathi . . . 91

PAGE

Family Characinidæ . . . . . 91
Order 5. Nematognathi . . . . . 91
Family Siluridæ (Catfish; bullheads) . . . . . 91
Order 6. Haplomi . . . . . 97
Family 1. Umbridæ (Mud minnows) . . . . . 97
Family 2. Esocidæ (Pike and pickerel) . . . . . 98
Family 3. Pœciliidæ (Killifish) . . . . . 100
Family 4. Amblyopsidæ (Blind fishes) . . . . . 107
Order 7. Synentognathi . . . . . 108
Family Exocœtidæ (Billfish) . . . . . 108
Order 8. Acanthopteri (Spiny-rayed fishes) . . . . . 108
Key to the suborders of Acanthopteri . . . . . 108
Suborder 1. Hemibranchii . . . . . 109
Family Gasterosteidæ (Sticklebacks) . . . . . 109
Suborder 2. Salmopercæ (Trout perch) . . . . . 111
Family Percopsidæ . . . . . 111
Suborder 3. Percesoces . . . . . 112
Family Atherinidæ (Silversides) . . . . . 112
Suborder 4. Percoidei . . . . . 113
Family 1. Aphredoderidæ (Pirate perch) . . . . . 113
Family 2. Elassomidæ (Pigmy sunfish) . . . . . 114
Family 3. Centrarchidæ (Sunfish; black bass) . . . . . 114
Family 4. Percidæ (Perch; darters) . . . . . 121
Family 5. Serranidæ (White bass; striped bass; yellow bass) . . 137
Family 6. Sciænidæ. (Drums) . . . . . 138
Suborder 5. Holconoti (Surf fishes) . . . . . 139
Family Embiotocidæ . . . . . 139
Suborder 6. Chromides . . . . . 139
Family Cichlidæ . . . . . 139
Suborder 7. Loricati . . . . . 139
Family Cottidæ (Sculpins) . . . . . 139
Suborder 8. Gobioidei . . . . . 142
Family Gobiidæ (Gobies) . . . . . 142
Suborder 9. Anacanthini . . . . . 142
Family Gadidæ (Cods) . . . . . 142
Suborder 10. Heterostomata (Flat-fishes) . . . . . 143
Family Soleidæ . . . . . 143
CLASS 2. AMPHIBIANS . . . . . 144
History . . . . . 144
Number and distribution . . . . . 145
Key to the orders of Amphibia in the United States . . . . . 145
Order 1. Caudata (Salamanders) . . . . . 145
On the identification of caudate Amphibia . . . . . 146
Key to the suborders of the Caudata . . . . . 147
Suborder 1. Proteida . . . . . 147
Family Proteidæ (Mudpuppies) . . . . . 147
Suborder 2. Mutabilia (Salamanders; newts) . . . . . 147
Family 1. Amphiumidæ (Congo snakes) . . . . . 148
Family 2. Cryptobranchidæ (Hellbenders) . . . . . 148
Family 3. Ambystomidæ (Salamanders) . . . . . 148
Family 4. Salamandridæ (Newts) . . . . . 152
Family 5. Plethodontidæ (Salamanders) . . . . . 154
On the identification of the larvæ of the Plethodontidæ . . . . . 165

PAGE

Suborder 3. Meantes . . . . . 166
Family 1. Sirenidæ (Mud eels) . . . . . 166
Order 2. Salientia (Frogs; toads) . . . . . 166
On the identification of the Salientia . . . . . 168
1. The adult . . . . . 168
Family 1. Discoglossidæ . . . . . 168
Family 2. Pelobatidæ (Spadefoot toads) . . . . . 169
Family 3. Bufonidæ (Toads) . . . . . 170
Family 4. Hylidæ (Tree toads) . . . . . 174
Family 5. Ranidæ (Frogs) . . . . . 179
Family 6. Brevicipitidæ (Narrow-mouthed toads) . . . . . 184
2. The eggs and larvæ . . . . . 185
CLASS 3. REPTILES . . . . . 188
History . . . . . 188
Number of species and distribution . . . . . 188
Key to the orders of Reptiles . . . . . 188
Order 1. Crocodilia . . . . . 189
Habits and distribution . . . . . 189
Family Crocodylidæ (Alligators; crocodiles) . . . . . 189
Order 2. Lacertilia (Lizards) . . . . . 191
Habits and distribution . . . . . 191
On the identification of lizards . . . . . 191
Family 1. Gekkonidæ (Geckos) . . . . . 193
Family 2. Eublepharidæ (Geckos) . . . . . 193
Family 3. Iguanidæ (Iguanas; swifts) . . . . . 193
Family 4. Anguidæ . . . . . 202
Family 5. Anniellidæ . . . . . 203
Family 6. Helodermatidæ . . . . . 204
Family 7. Xantusiidæ . . . . . 204
Family 8. Teiidæ (Swifts) . . . . . 204
Family 9. Scincidæ (Skinks) . . . . . 205
Family 10. Leposternidæ . . . . . 207
Order 3. Serpentes (Snakes) . . . . . 208
Habits and distribution . . . . . 208
On the identification of snakes . . . . . 209
Family 1. Leptotyphlopidæ . . . . . 211
Family 2. Boidæ (Boas) . . . . . 211
Family 3. Colubridæ (Colubrine snakes) . . . . . 211
Family 4. Elapidæ snakes (Elaphine snakes) . . . . . 230
Family 5. Crotalidæ (Viperine snakes; rattlesnakes) . . . . . 230
Order 4. Testudinata (Turtles) . . . . . 234
Habits and distribution . . . . . 235
On the identification of turtles . . . . . 235
Family 1. Kinosternidæ (Mud turtles; musk turtles) . . . . . 237
Family 2. Chelydridæ (Snapping turtles) . . . . . 239
Family 3. Testudinidæ (Pond turtles; land turtles) . . . . . 239
Family 4. Trionychidæ (Soft-shell turtles) . . . . . 249
Family 5. Cheloniidæ (Marine turtles) . . . . . 250
Family 6. Demochelidæ (Marine turtles) . . . . . 251
CLASS 5. MAMMALS . . . . . 252
On the identification of mammals . . . . . 252
History . . . . . 254

PAGE

Key to the orders of mammals in the United States . . . . . 254
Order 1. Marsupialia . . . . . 254
Suborder Polyprotodontia . . . . . 255
Family Didelphyidæ (Opossums) . . . . . 255
Order 2. Edentata . . . . . 256
Family Dasypodidæ (Armadillos) . . . . . 256
Order 3. Sirenia . . . . . 256
Family Trichechidæ (Manatees) . . . . . 256
Order 4. Insectivora . . . . . 256
Family 1. Talpidæ (Moles) . . . . . 257
Family 2. Soricidæ (Shrews) . . . . . 260
Order 5. Chiroptera (Bats) . . . . . 265
Suborder Microchiroptera . . . . . 265
Family 1. Phyllostomidæ . . . . . 265
Family 2. Vespertilionidæ . . . . . 267
Family 3. Molossidæ . . . . . 272
Order 6. Carnivora . . . . . 273
Family 1. Ursidæ (Bears) . . . . . 273
Family 2. Canidæ (Dogs; wolves; foxes) . . . . . 274
Family 3. Procyonidæ (Racoons) . . . . . 279
Family 4. Mustelidæ . . . . . 280
Subfamily 1. Mustelinæ (Weasels; minks) . . . . . 281
Subfamily 2. Mephitinæ (Skunks) . . . . . 287
Subfamily 3. Melinæ (Badgers) . . . . . 291
Subfamily 4. Lutrinæ (Otters) . . . . . 292
Family 5. Felidæ (Cats) . . . . . 293
Order 7. Pinnipedia (Seals) . . . . . 296
Family 1. Otariidæ . . . . . 296
Family 2. Phocidæ . . . . . 297
Order 8. Rodentia (Rodents) . . . . . 298
Family 1. Muridæ (Rats; mice) . . . . . 298
Subfamily 1. Murinæ (House-rats and mice) . . . . . 299
Subfamily 2. Cricetinæ (Field mice; wood mice) . . . . . 299
Subfamily 3. Neotominæ (Wood rats) . . . . . 310
Subfamily 4. Microtinæ (Meadow mice; muskrats) . . . . . 313
Family 2. Geomyidæ (Pocket gophers) . . . . . 323
Family 3. Heteromyidæ (Pocket mice; kangaroo rats) . . . . . 328
Family 4. Zapodidæ (Jumping mice) . . . . . 333
Family 5. Erethizontidæ (Porcupines) . . . . . 335
Family 6. Aplodontiidæ (Mountain beavers) . . . . . 336
Family 7. Sciuridæ (Squirrels; marmots) . . . . . 336
Family 8. Castoridæ (Beavers) . . . . . 353
Family 9. Leporidæ (Rabbits; hares) . . . . . 354
Order 9. Ungulata (Hoofed animals) . . . . . 361
Suborder Artiodactyla . . . . . 361
Division 1. Suina (Pigs) . . . . . 361
Family Tayassuidæ (Peccaries) . . . . . 362
Division 2. Ruminantia . . . . . 362
Subdivision 1. Cervina (Deer) . . . . . 362
Family Cervidæ . . . . . 362
Subdivision 2. Cavicornia . . . . . 366
Family 1. Antilocapridæ (Prong-horn antelopes) . . . . . 366

PAGE

Family 2. Bovidæ (Cattle; sheep; goats) . . . . . 366
BIBLIOGRAPHY . . . . . 369
GLOSSARY . . . . . 382
LIST OF AUTHORS . . . . . 385
INDEX . . . . . 393

# VERTEBRATE ANIMALS OF THE UNITED STATES

## VERTEBRATES

Vertebrates are bilaterally symmetrical animals with an internal cartilaginous or bony skeleton; with usually two pairs of locomotory appendages, the fore and hind limbs; with pharyngeal respiration; with a tubular dorsal central nervous system; with a ventral heart, a closed blood circulation and red blood.

The vertebrates are characterized as a group among animals by their large size and the high degree of specialization of many of their parts, and also by their general distribution over the earth. Every part of the surface of the globe, as well as the ground and the waters beneath and the air above it in which animals can in any way satisfy the need of all life of food and oxygen, is inhabited by them. The fishes and other aquatic forms abound in fresh and salt water, while the terrestrial and flying vertebrates inhabit all the continents, even the coldest and most inclement.

**External Characters.**—The vertebrate body is in most cases more or less cylindrical in form, and is made up of four regions, the head, the neck, the trunk and the tail. The *head*, being the anterior portion of the body, bears the principal organs of orientation, which are the special sense organs, and the organs of prehension—the mouth with the lips and teeth where these are present; it also contains the large brain, which innervates these essential organs, enclosed, for its protection, in the skull. The *neck* is absent or unimportant in fishes and other aquatic vertebrates, but in most of the land forms is of great importance inasmuch as it is the flexible body region which gives the head the wide range of movement necessary to it in a rapidly moving terrestrial animal. In fishes the head and anterior portion of the body forms a wedge which must be pushed by the locomotory movements of the tail-fin through a resistant medium, and it is greatly to the advantage of the animal that the head be joined solidly with the trunk and without

the interposition of a flexible body region, which would lessen the driving power of the caudal fin. Fishes, also, in their watery environment, do not depend so much on the sense of sight and the other special senses located in the head to orient themselves as do the land animals, because the density of the medium in which they live limits the carrying power of these senses, but they depend rather upon the lateral line sense and other special senses which reside in the skin over the whole body and are affected directly by the water surrounding it. Fishes are, consequently, often sufficiently oriented with regard to their environment without moving, and may be observed to lie motionless in the water for long periods of time.

The *trunk* contains the principal viscera and is the largest and bulkiest body region; in it also are the places of attachment of the two pairs of limbs. In the terrestrial vertebrates the trunk may be subdivided into two or three subregions, the thoracic subregion which with the fore limbs forms the anterior portion, the sacral subregion, forming with the hind limbs the posterior portion, and, in four-footed vertebrates, the lumbar subregion which lies between the other two and forms the pivot where the body bends when the direction of movement is changed.

The paired limbs are wanting in the cyclostomate fishes, the most primitive vertebrates, and also in snakes and certain species of lizards. The anterior pair is wanting in certain species of fishes, and the posterior pair in many fishes and also in *Siren* among the amphibians and in the *Cetacea* and *Sirenia* among the mammals. The paired appendages of fishes are the pectoral and ventral fins, which are flattened swimming organs stiffened by radiating bony and cartilaginous rods. In the other classes of vertebrates they are more or less cylindrical in form and each is made up of three main divisions. The proximal division projects directly from the trunk and articulates with it; the distal division of the appendages is applied to the substratum or medium on or in which the animal is moving, and is the most complex of the three in structure, terminating typically in the five digits. This number has, however, undergone a reduction in very many vertebrates —in extreme cases, like that of the horse, only one digit being present on each foot. In the four-footed vertebrates, also, the fore and hind pairs differ, in most cases, in the number of their digits and the essential uses to which they are put, the hinder pair having a smaller number than the forward pair, as is the case, for instance, in cats and dogs; inasmuch as the hinder pair principally propels the animal, the fewer its points of contact with the ground the greater will be its effectiveness.

In the *Primates* the digits may be used for prehensile purposes; in the flying vertebrates, the birds and bats, the fore limbs become wings.

The *tail* of vertebrates is the postanal portion of the body, and is the principal organ of locomotion in most aquatic forms. In the terrestrial representatives it has lost its primitive significance and varies much among the various groups in relative length as well as in function, and may be rudimentary or absent altogether.

The *integument* of vertebrates, which forms the outer covering of the body, consists of two distinct layers, the outer epidermis and the inner dermis, and its effectiveness as a protective envelope is increased by the growth of additional characteristic coverings, such as the bony dermal scales of fishes and the horny epidermal scales and plates of reptiles, feathers of birds and hair of mammals. The epidermal layer of the integument is soft and slimy in fish and amphibians, which live in or near the water, while in terrestrial vertebrates, whose bodies are exposed to the air, it becomes more or less hard and horny and the special integumental coverings of the land forms just mentioned appear as specializations of it.

One of the most conspicuous of the external characters of vertebrates, as well as of other animals, and consequently important in the classification of them, is their coloration. This is also a feature of great importance to the animal itself in its relation to its environment, inasmuch as in a large class of cases the coloration of an animal tends to render it inconspicuous to its enemies and to its prey, and perhaps to increase the absorption of heat from the atmosphere or to prevent the too great radiation of bodily heat to it. The same color pattern, however, in numerous cases does not characterize all the individuals of a species, the males being often colored differently from the females and the young individuals from the adults. The summer coat is also often different from the winter coat in color and markings. The practical purpose of these differences is sometimes hard to explain, but can often be correlated with the habits of animals and the need of concealment and protection at different times of the year and during different periods of growth. A few species are dichromatic, there being two color phases which may characterize individuals. The gray squirrel and the black bear are familiar examples, gray and black squirrels appearing in the same litter and black and brown (cinnamon) individuals in the same family of bears. Metachrosis, or the rapid change in color under the influence of external stimuli, is common among fishes, amphibians and lizards. Brown and green tones may alternate with each other in frogs and toads, mainly under the stimulus

of light; the so-called chameleon of our southern States and many other lizards have a still more remarkable range of color change. Very old individuals in all the classes of vertebrates often show differences in coloration and markings which are due to wear and the fading of colors or loss or injury of parts.

**Internal Characters.**—Characteristic of vertebrates, and often of importance in classifying them, is the *internal skeleton*, which forms the supporting framework of the body. In the most primitive fishes this framework is composed entirely of cartilage and the ligaments and membranes which serve to bind its various parts together; in the higher fishes and all the other vertebrates it is formed principally of bone. The ratio of the cartilage to the bone that forms the skeleton varies much among vertebrates in the classes above fishes, it being the largest in the amphibians and the smallest in the birds. The backbone, the main skeletal axis of the body, is a flexible segmented column consisting of a succession of the similar disk-like or cylindrical vertebræ which grow around the unsegmented embryonic rod-like notochord and are bound together by intervertebral ligaments. The vertebræ forming the column may vary in number in the various classes of vertebrates, ranging from 6 in certain amphibians to 300 in some snakes; they fall into groups which correspond to the main subdivisions of the body of the animal. The skull, or anterior portion of the axial skeleton, is composed of two parts, the cranium, which encloses and protects the brain and the organs of special sense, and the visceral skeleton, which surrounds the mouth and forms the framework of the face, the jaws, the tongue and the gills, where they are present. These two portions of the skull, which protect and support such diverse organs, develop quite distinct from each other, and are but loosely bound together in fishes, and more or less so in all other vertebrates in which the mouth is employed mainly in seizing the food and not in masticating it. In the mammals, however, which masticate their food, the need of a solid base to chew against has brought about a firm union of the visceral with the cranial portions of the skull, which is thus given the compact character which distinguishes it.

The other internal organs in vertebrates are usually of less importance in classification, although the entire inner structure of the vertebrate body bears the characteristic stamp of the group. This is especially true of the *circulatory system*—the ventrally situated heart, the closed system of blood tubes and the red blood corpuscles. The heart is made up primarily of two portions, an anterior and a posterior, into the former of which the blood is poured by the veins,

while from the latter it is discharged through the arteries and distributed to the respiratory organs and throughout the body. In mammals and birds, whose bodies maintain a constant, relatively high temperature, without regard to that of the medium in which they are living or the time of year, each of these portions of the heart is subdivided by a septum, so that the heart in these animals is composed of two pairs of chambers, the anterior pair forming the right and left auricles and the posterior pair the right and left ventricles; the right chamber in each pair contains venous blood which has been brought exhausted of oxygen and charged with carbon dioxide from the various organs of the body and the left chamber contains arterial blood brought purged of carbon dioxide and with oxygen renewed directly from the lungs. It is this complete separation of the venous from the arterial sides of the heart which results in the distribution of pure unmixed oxygenated blood over the body and the consequent maintenance in it of a relatively high and also constant temperature.

In reptiles and amphibians, on the other hand, the ventricle is not thus divided into two completely separated chambers, but there is a communication of greater or less extent between its venous and arterial sides, and in consequence the freshly oxygenated blood in the left division is more or less diluted by the venous and vitiated blood in the right division before it is pumped through the arteries over the body. Metabolism, consequently, which bears a direct relation to the oxygen content of the blood, cannot be so active as in birds and mammals; the body temperature is not maintained at a constant level but is dependent to a certain extent on the temperature of the surrounding medium and varies with it.

The heart of fishes contains venous blood only, the auricle and ventricle not being divided into right and left halves (except partially so in the *Dipnoi*); the blood is sent to the gills from the heart, where it is oxygenated, and then distributed directly throughout the body without first returning to the heart.

The process of *respiration*, by which an animal or plant takes in oxygen from the surrounding medium and gives off carbon dioxide, is performed by a radically different body surface in vertebrates than in invertebrates. Being a transfusion process it requires a moist surface, and consequently while it may be performed by an aquatic animal through the outer surface it must be carried on by land animals in the interior of the body. The aquatic invertebrates, with the exception of the chordate forms, respire directly with the integument or with organs derived from it. The vertebrate, on the other hand, in common with

all chordate animals, respires directly with the pharynx, the anterior portion of the digestive tract, and with structures derived from the pharynx; the medium in which the animal lives, whether water or air, must be drawn through the mouth into the respiratory organs by an incessently repeated muscular effort, the interruption of which, only for a few moments, will often kill the animal. In fishes the gills are paired lateral pockets of the pharynx which open through the integument to the outside; through these the breathing motions of the animal maintain never ceasing streams of water from which the thin-walled, delicately branched gill filaments absorb the respiratory air.

In amphibians the larval forms, and to a large extent the adults as well, respire after the manner of invertebrates, by means of the integument. All amphibians, however, in the adult condition, respire also directly with the surface of the pharynx, and also in most species with the lungs, which arise as a ventral diverticulum of it, as well. The importance of direct pharyngeal respiration is shown by the rapid and regular respiratory movements of the throat of salamanders and frogs when in the air, which affect the pharynx alone and do not serve to introduce air into the lungs, and also by the total lack of lungs in a large group of salamanders. Amphibians are the oldest and most primitive terrestrial vertebrates; direct pharyngeal respiration was probably the earliest method among vertebrates of utilizing the atmospheric air for respiratory purposes, and may have grown out of the habit, not uncommon among fishes, of rising to the surface of the water and swallowing air. The lungs, in the earliest amphibians, were probably primarily hydrostatic organs like the air-bladder of fishes, a function they still retain in many primitive salamanders, and to a certain extent probably in all amphibians.

In the amniotic vertebrates respiration is exercised by the lungs exclusively rather than by the pharynx directly, and the complexity of their structure in each group of such animals bears a direct relation to the intensity of the metabolism in that group. The cold-blooded, sluggish reptiles have sack-like lungs with relatively large and relatively few lung vesicles. The lungs of the warm-blooded vertebrates, on the other hand, which maintain a constant temperature in their bodies without reference to the surrounding medium, contain a dense mass of minute vesicles which represent a very much larger relative absorptive surface and gives the lungs the spongy texture characteristic of them, the birds with their higher temperature possessing lungs with smaller vesicles and consequently a larger relative surface than the mammals.

The union of the *digestive tract* in vertebrates with the respiratory, just alluded to, is peculiar to them and to chordates. The paired gill clefts in the lateral walls of the pharynx and the paired visceral arches which form their skeletal support are universal throughout the group and are not found in other animals. The character and position of the mouth and the jaws and their relation to the gill system are especially noteworthy. In the great group of *Arthropoda* the organs of mastication are modified limbs and are lateral in position; in the *Mollusca* these organs, where they are present, are cuticular or calcareous thickenings on the surface of the mouth or pharynx, and the same is true of other invertebrate groups. In vertebrates, however, the jaws have a dorsoventral position, and they and the slit-like mouth have had their origin respectively from the foremost pair of visceral arches and the foremost pair of primitive gill-clefts. The fact that the cyclostomate fishes, the most primitive vertebrates, are without jaws seems to indicate that the earliest vertebrates, like them, possessed a circular jawless mouth armed with cuticular teeth and with a series of about seven pairs of gill-clefts supported by cartilaginous arches posterior to it. When the true fishes, the ancestors of all other vertebrates, developed from a cyclostomate stock, the foremost two pairs of cartilaginous arches and the foremost two pairs of gill-clefts lost their primitive functions and were transferred from the respiratory to the digestive system of organs. The foremost pair of gill-clefts became the mouth while the foremost pair of arches reinforced by dermal bones formed the upper and lower jaws; the second pair of clefts became the spiracles in the elasmobranch fishes and the Eustachian tubes in the terrestrial vertebrates, while the second pair of arches formed the skeletal support of the tongue. The remaining five pairs of arches are gill-bearing in the fishes and support the gill-clefts; in the terrestrial vertebrates, however, they undergo a change of function during the embryonic period and lose their primary significance, being transformed into the cartilages of the larynx and trachea.

The teeth of all vertebrates are identical in structure, being composed of dentine overlaid with enamel, and the identity of this structure with that of the placoid scales of the lowest of the true fishes shows that vertebrate teeth are directly derived from these scales. The actual form of the teeth in each group has been determined by the service they are expected to perform. In most fishes, amphibians and reptiles the teeth are employed only for grasping and holding the prey; they are conical in shape like a placoid scale and are usually more or less loosely attached in the oral cavity. In mammals, which use their teeth not

only for grasping but for chewing their food, the teeth are firmly set in alveoli—deep cavities in the jaw bone—and have a variety of forms which fit them for grasping, cutting, gnawing or chewing. The teeth of alligators and the extinct toothed birds occupy a mid-way position, being elongated cones in form and set in alveoli.

The digestive canal in vertebrates is characterized in general by great length and by the presence of two digestive glands of large size, the liver and pancreas, which originate as outgrowths of it, also by the mesenteries in the body cavity which support its various divisions. The intestine opens at the hinder end either directly to the outside through the anus, or into a cloaca which receives also the discharges of the excretory and reproductive organs.

The *excretory* and *reproductive systems* are closely associated in vertebrates, often possessing ducts in common through which their products find a way to the outside. Reproduction is in all cases sexual; with a few exceptions among fishes the sexes are separate; sexual dimorphism is universal.

The *central nevvous system* of vertebrates, the spinal chord and brain, has no homologue among invertebrates. It originates in the embryo as a middorsal ectodermal groove, which sinks beneath the surface and forms a tube. The anterior portion of this tube widens and forms a series of five vesicles the walls of which become thick and folded, and the brain comes into existence; the posterior portion becomes the spinal chord. The cranial and spinal nerves proceeding from the brain and spinal chord to the special sense organs and the muscles of the trunk and appendages have a metameric arrangement; the same is true also of the sympathetic nervous system, which is intimately joined with them and controls the activities of many of the viscera.

The characteristic *special senses* of vertebrates are smell, taste, sight and hearing. The sensory perceptions of aquatic vertebrates, especially fishes, are in many respects sharply different from those of animals which live in so attenuated a medium as the air, vibrations of the water being the most important stimulating agents which cause their sensory reactions. Vibrations of very low frequency, such as are produced by impacts on the water, currents and surface waves, undoubtedly affect the skin over the whole surface of the fishes body; the lateral line, which is a specialized portion of the skin, is sensitive to vibrations of higher frequency, such as slight oscillations of the whole mass of the water, which are, however, too slight to stimulate the skin itself; the ear, which is a modified portion of the lateral line, is attuned to vibrations of still higher frequency, such as cause the sensa-

tion of sound. The ears of the lowest fishes, however, notably the cyclostomes and selachians, have not reached a development high enough to be stimulated by tonal vibrations, although they may be by noises sufficiently loud to produce vibrations which affect the skin or lateral line; the ear of such fishes is apparently merely an organ of equilibrium, the maintenance of which is probably the primitive function of the vertebrate ear.

In aquatic vertebrates taste and smell are similar senses, causing similar reactions and having a similar purpose, which is the detection of food. Taste buds, in many fishes, especially bottom feeders, are not only present in the mouth, but are distributed over the skin, so that such fishes may be conscious of the presence of food which is near any part of the body, the pectoral fins and barbels being especially sensitive. Smell is probably perceived by fishes with the nostrils alone, and enables the animal to scent its food at a distance.

The eyes of fishes and amphibians are adapted to near vision only, inasmuch as they have a spherical lens and lack the ciliary muscles by means of which the land animals accommodate their vision to the perception of distant objects. In many fishes the whole skin is also sensitive to light, independently of the eyes, the head and tail being more so than the trunk.

The change in their sensory reactions which took place in vertebrates when the terrestrial forms first developed from the aquatic is well illustrated in the transformation of the tadpole into the frog. The tadpole has the sensory equipment of a bottom fish, and undoubtedly depends largely on vibrations of the water for its means of orientation; the lateral line is well developed, the ear does not appear at the surface of the head, there being no tympanum, and the eye is small and sunken. The frog, on the other hand, depends upon sight and hearing for its knowledge of its surroundings; it has very large projecting eyes, the tympanum is at the surface of the head and no lateral line is present. Thus, in the terrestrial vertebrates the general or contact sense, so important to fishes, falls into the background as a means of orientation. In frogs, toads and reptiles, generally, which are the lowest of them, sight is apparently the best developed special sense, and the one most depended upon for information of the surroundings; also in frogs and many lizards, and undoubtedly in others too, the whole skin is sensitive to light, independently of the eyes. Hearing, smell and taste are all poorly represented.

Birds also depend largely upon sight, and this sense has attained an extraordinary development in many species. The accurate vision

of birds during swift flight and over great distances, and the instantaneous accommodation of it to their rapid manœuvres in the air, seem to indicate that birds have the best eyes among vertebrates. Hearing is also highly developed in birds; smell and taste, however, are apparently in a backward condition.

In mammals all the special senses have reached a very high development. As the bird is essentially a creature of the air and must be able to see far and accurately, so the mammal belongs on or near the ground and in most cases finds its greatest security and advantage in its remarkable sense of smell. But its habit of life, which gives the mammal the most varied environment among vertebrates, makes all the special senses important to it, and has brought about the high state of perfection which characterizes all of them.

The *muscular system* of vertebrates has but few distinctive features. The body or somatic muscles of fishes and salamanders, which, being aquatic animals, move through the water by alternate to-and-fro movements of the trunk and tail, have a strictly metameric arrangement and longitudinal fibres, and the appendicular muscles of all vertebrates, although not metameric, are directly derived from them; both are striated in structure and voluntary in character. The body muscles of terrestrial vertebrates, however, especially those whose locomotory movements are carried on exclusively by the appendages, have mostly lost their primitive character, although it is still indicated in several of them, notably the *rectus abdominis*. The attachment of a muscle to a bone by a single tendon, by which the action of all the fibres is concentrated on a single point, is a peculiarly vertebrate character. The visceral muscles, which are involuntary and, with a few exceptions, unstriated, are present in the walls of the various tubular internal organs to which they impart the peristaltic movements characteristic of them.

**Distribution.**—The United States covers an area of continental extent containing the greatest possible variety of conditions which may surround the lives of the animals living within it. Certain physical features of this area strike the attention of the observer as of especial importance. Of these the following may be mentioned; the great extent and number of the fresh water lakes in the northern portion of the country, the great river basins which characterize almost every part of it and especially that of the Mississippi, the mountain systems in the East and the West, the extensive coastal plains bordering the Atlantic Ocean and the Gulf of Mexico, the great forested regions in both the eastern and western States, the well-watered, treeless prairies, the

high, dry Great Plains, and the arid and mountainous Great Basin. Climatic conditions vary from the tropical heat and constant temperature of southern Florida and the Mexican border to the Arctic cold and violent and sudden changes of the Canadian border and the high mountain regions, and conditions of moisture from the excessively wet western slopes of the Cascades which look towards the Pacific to the deserts of the Great Basin and the extreme southwest.

The actual extent of territory occupied by any species of animal is determined by several factors, of which the most important are probably temperature and amount of moisture, both of which tend to check the migration of species and to confine them within certain more or less definite boundaries. The United States Biological Survey, has formulated the following two fundamental Laws of Temperature Control of Distribution: First, the northward distribution of terrestrial animals and plants is governed by the total quantity of heat during the season of growth and reproduction; Second, the southward distribution is governed by the mean temperature of a brief period during the hottest part of the year. The meaning of these laws is that each species requires a certain minimum total quantity of heat during the period of the year when growth and reproduction are going on, which is the summer season in temperate regions, and that this factor establishes the northern limit of its distribution: also, that excess of heat through a sufficiently long portion of this period tends to check or stop growth and reproduction, and consequently the mean temperature of the mid-summer weeks, when the heat is the greatest, is the factor which establishes the southern limit of distribution of a species.

On the basis of these laws the North American continent has been divided into three Life Regions, the *Boreal*, *Austral* and *Tropical*, the first two of which have been subdivided each into three Life zones. The *Boreal Region* is the portion of the continent north of the Canadian boundary, and is composed of the *Arctic*, *Hudsonian* and *Canadian zones*, each transcontinental in extent. The *Arctic zone* is the circumpolar region north of the northern limit of forests; it is the home of the muskox, polar bear, Arctic fox, wolf and hare and barren-ground caribou. The *Hudsonian zone* is the region of firs and spruces which extends as a wide belt between Labrador and Alaska, and southwards along the main ridge of the Rockies into the United States, and occurs also in limited areas in several high mountain regions in the Rockies and Cascades; it is the home, in Canada, of the woodland caribou, moose and wolverine. The *Canadian zone* is the region of the great coniferous forests and occupies southern Canada, extending extensively into the

eastern and central northern United States, the higher Alleghanies and the mountains of the West.

The *Austral Region* comprises the greater part of the United States, and is composed of the *Transition, Upper Austral* and *Lower Austral zones,* each transcontinental in extent, the limits of which may be seen by reference to the frontispiece. The life conditions of the eastern and western portions of these three zones are greatly affected by the differences in the precipitation of moisture in them. The one-hundredth meridian represents the approximate boundary between the well-watered prairies and the arid Great Plains, to the eastward of which the annual rain-fall is greater than 25 inches and to the westward it is less than that amount, except on the Pacific coast. The eastern divisions of the three Austral zones are also called the *Alleghanian, Carolinian* and *Austroriparian,* respectively, and the two most southerly western divisions are also called the *Upper Sonoran* and *Lower Sonoran.*

The *Tropical Region* comprises the southern portion of the continent and occupies only a small part of this country, being limited to the southern end of Florida, south of Lake Worth, and perhaps the valley of the lower Colorado.

**History.**—The first person in modern times to unite the different classes of vertebrates in a single phylum was the French naturalist Lamarck, who, near the beginning of the 19th century, divided all animals into the two groups of those with vertebræ and those without. Aristotle, in his time, pointed to the same fundamental subdivision of the animal kingdom when he contrasted the several classes possessing red blood with those apparently without blood, their blood being colorless. The Swedish naturalist Linnæus, the founder of the modern system of classifying animals and plants, who lived in the generation immediately preceding Lamarck, did not take notice of the interrelationship of the classes of vertebrates notwithstanding the example of Aristotle, but gave each of these classes equal rank in his system with the invertebrate groups. Cuvier, who was a younger contemporary and fellow-countryman of Lamarck, adopted the term *Vertebrata* introduced by him as one of the four fundamental types into which he divided the Animal Kingdom, and the group maintained this rank in the zoological system of classification until about the seventh decade of the last century. At that time the epoch-making researches of Kowalevsky and others having shown the relationship of vertebrates with ascidians, Amphioxus and Balanoglossus, a new phylum was formed, first by the German zoologist Hæckel, to include these groups, which received the

name *Chordata*, under which the *Vertebrata* are now commonly rated a subphylum.

The primary subdivisions of this subphylum was first made by Aristotle, who recognised four groups, namely, fishes, oviparous tetrapodous and apodous vertebrates (amphibians and reptiles), birds, and viviparous vertebrates (mammals). Linnæus recognised the same four groups and named them classes in his system, giving them the modern names of *Pisces*, *Amphibia*, *Aves* and *Mammalia*, but he did not unite them in a single phylum. In Cuvier's system the same classes were also recognised, but for the name of the second class the term *Reptilia* was employed in place of *Amphibia*. This system was maintained in the classification and the amphibians and reptiles placed in a common class until about the year 1850, when the French zoologist Milne-Edwards called attention to the fundamental subdivision of all vertebrates into two great groups, the *Anamia* and the *Amniota*, and also to the fact that inasmuch as the *Amphibia* belong to one and the *Reptilia* to the other of these groups these two subdivisions of the *Vertebrata* should each constitute an independent class. Of the five classes of vertebrates thus formed the English naturalist Huxley in 1871 formed three divisions, the *Ichthyopsida* or fish-like vertebrates, the *Sauropsida* or reptile-like vertebrates and the *Mammalia*.

**Classification.**—About 33,400 species of vertebrates have been described, grouped in 5 classes, of which about 12,000 species are fishes, 1,400 are amphibians, 3,500 are reptiles, 13,000 are birds and 3,500 are mammals. The primary grouping of these classes gives the following subdivisions:

A. *Anamia or Ichthyopsida.*—Vertebrates whose eggs are deposited in most cases in the water and are without a shell; and whose embryos are protected only by an albuminous envelope and the water and not by an amnion; which respire by means of gills either during the whole or a part of life; and which have a slimy epidermis lacking special epidermal coverings (Fishes and Amphibians).

B. *Amniota.*—Vertebrates whose eggs (in the oviparous species) are laid on the land and have the protection of a shell; whose embryos have the additional protection of an amnion and respire by means of an allantois; which respire after birth by means of lungs; and have special epidermal coverings in form of scales, feathers or hair.

1. *Sauropsida.*—Vertebrates which produce a very large egg and are either oviparous or ovoviviparous; which have a single median occipital condyle, and epidermal coverings in form of scales or feathers (Reptiles and Birds).
2. *Mammalia.*—Vertebrates which produce a minute egg (except the Monotremata), and are viviparous with uterine embryonic development; which nourish the young by means of mammary glands; which have a pair of occipital condyles, and an epidermal covering in form of hair (Mammals).

### Key to the Classes of Vertebrates

$a_1$ Aquatic vertebrates whose locomotory appendages are fins.....1. *Fishes.*
$a_2$ Aquatic or land vertebrates with legs or wings as locomotory appendages, or without them.
  $b_1$ Body naked (in American species), being without special integumentary coverings; toes without claws or nails.....2. *Amphibians*
  $b_2$ Body not naked, but with special integumentary coverings; toes with claws or nails.
    $c_1$ Body covered with horny scales or plates.....3. *Reptiles.*
    $c_2$ Body covered with feathers.....4. *Birds.*
    $c_3$ Body covered with hair.....5. *Mammals.*

## CLASS 1. FISHES

Aquatic, cold-blooded vertebrates which have an integumentary covering of dermal scales or plates, and which breathe by means of pharyngeal gills. Median and paired fins are in most cases present, the latter being homologous to the limbs of the higher vertebrates. The heart has but one ventricle and one auricle, and contains only venous blood. The head is joined with the trunk without articulation, and there is no neck. No external ear-opening is present. With a few exceptions all fishes lay eggs, which develop without an amnion.

**Number of Species and Distribution.**—About 12,000 species of fishes have been described, of which about 600, grouped in about 34 families and 2 subclasses, live in the fresh waters of the United States. Of these families the largest are the *Cyprinidæ* with 230 species and the *Percidæ* with 72 species; the *Cyprinodontidæ* with 52 species and the *Catostomidæ* with 51 species are the next in rank; and these four families include two-thirds of all the species of fresh water fishes in the country.

The fresh waters of the United States are very rich in species of fishes, as will be seen by a comparison with those of Europe, which, although having a land area of about the same extent and with a very varied surface, contains only about 125 species. It is the very large hydrographical basins of our country joined with its varied character and the relatively high temperature of the middle and southern portions of it which have brought about the multiplication of species of fishes within its borders. The Mississippi basin contains about 200 species and that of the Great Lakes about 150 species.

**History.**—Fishes, conspicuous and abundant animals as they are and important in the dietary of all peoples, have attracted the interest of naturalists from time immemorial. The modern scientific study of them is based upon the classifications of Peter Artedi and Linnæus, who wrote in the 18th century, and Cuvier, who wrote in the early part of the 19th. In recent times the most important single work is Günther's "*Catalogue of the Fishes of the British Museum*," published in 1859–70. This work and Boulenger's continuation of it published in 1898–1900 are fundamental for the modern systematic study of fishes. The fishes of America have attracted many brilliant students, the most eminent of the earlier ones being Louis Agassiz, who first placed the study of American fishes on a sound scientific

basis. Since his death in 1873 the school of ichthyologists founded by him has been directed and carried on by David Starr Jordan, one of his pupils, who together with his pupils and associates has made the fishes of North America better known than perhaps those of any other equally large area. The "*Fishes of North and Middle America*," by Jordan & Evermann (1896–1900) is the foundation of the descriptions of fishes in this book.

**On the Identification of Fishes.**—The body of most species of fishes is more or less lenticular in shape and compressed laterally. In many species, however, the anterior portion is cylindrical, as it is in the eel, or more or less depressed (flattened), as in the catfish. The head forms the anterior end of the body, the hinder margin of the opercles marking the boundary between it and the trunk. The caudal or tail fin forms the posterior end, the caudal peduncle being the slenderer portion of the body from which it projects.

**Measurements** (Fig. 1).—The *length* of a fish, as given in this book, is the distance between the tip of the snout and the base of the caudal fin, expressed in millimeters: the caudal fin is not included. The measurements of the *head* and of the *depth* (*i.e.*, the greatest dorso-ventral measurement) of the body are not given in millimeters or by any other absolute scale, but are relative, being the number of times the length of the body is greater than that of the head or the depth of the body, respectively. Thus, the expression "head 3, depth 5" means that the length of the body is 3 times the length of the head and 5 times its own depth.

**Fins** (Fig. 1).—The fins of fishes are of two kinds, the *median* or *vertical fins* and the *paired fins*. The *median fins* are the *dorsal*, *caudal* and *anal fins:* they are the more primitive of the two kinds, and alone occur in cyclostomate fishes. The *dorsal fin* lies in the middorsal plane and in many fishes is divided, so that there are two or even three or more of them. The *caudal* or *tail fin* is usually the largest and the principal organ of locomotion: its hinder margin may be either forked, concave, emarginate (slightly forked or notched), straight or rounded. In the sturgeon and many other primitive fishes the backbone takes an upward turn at the base of the caudal fin and continues in the fin to near its hinder end, so that the greater part of the fin is ventral to the backbone; such a tail is called *heterocercal* (Fig. 2). In most fishes, however, the caudal fin is *homocercal*, that is, the backbone extends only to the middle of the base of the fin, which projects fan-shaped back of it. The *anal fin* lies in the midventral plane behind the anus; it is in most cases single, but in some species is divided.

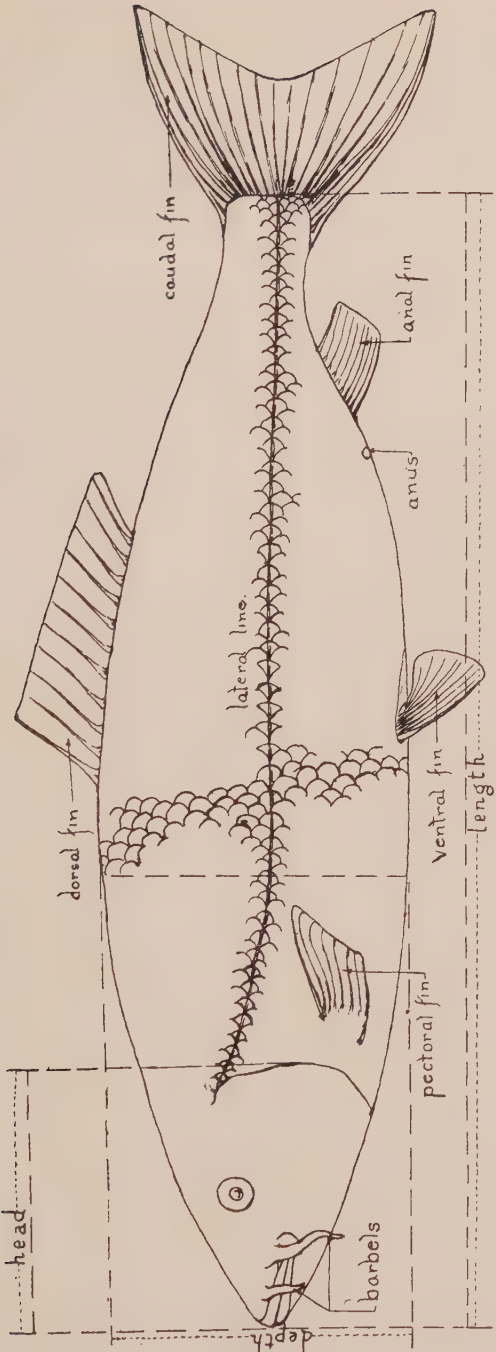


FIG. 1.—The external parts of a fish, and the names by which they are referred to in the descriptions.

The *paired fins* are the *pectoral fins*, which are anterior in position, and the *ventral fins*, which are posterior. The pectoral fins are immediately back of the head, either on the side of the body or on the breast. The ventral fins (Fig. 3) lie on the belly in front of the anus in the more primitive fishes, in which case they are said to be *abdominal* in position; in the more specialized fishes they are situated nearer the head, and are

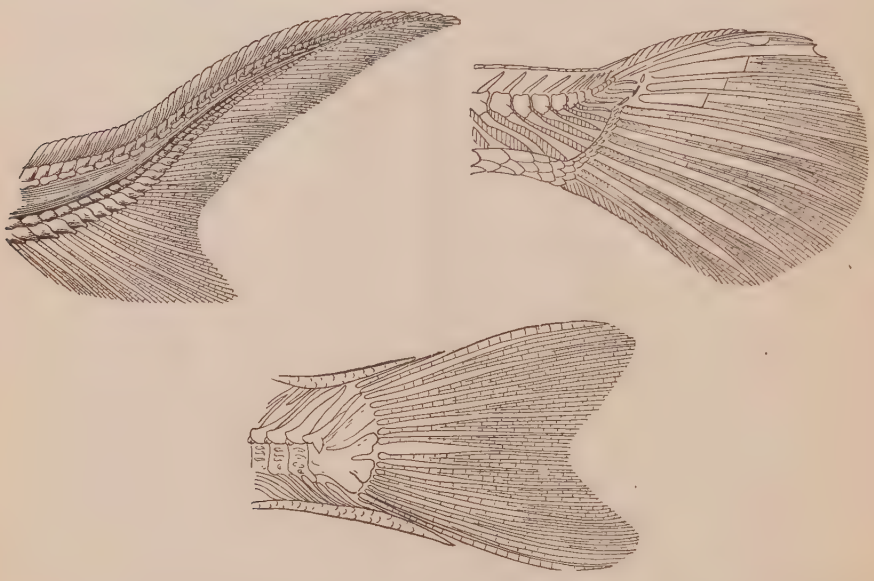

FIG. 2.—Types of tails of fishes: *a*, heterocercal tail of sturgeon (*Acipenser*); *b*, heterocercal tail of garpike (*Lepisosteus*); *c*, homocercal tail of pike-perch (*Stizostedion*) (*from Fishes of Illinois*).

said to be *thoracic* in position when they are immediately beneath the pectoral fins and *jugular* when they are in front of the pectoral fins.

The fins are stiffened and supported by slender bony rods called *the fin-rays* (Fig. 4). These are of two kinds, the *soft rays*, which are jointed and have divided or split terminal ends, and the *spiny rays*, which are stiff and not jointed and have undivided and sharp-pointed ends.

The position of the fins and the number of soft and spiny rays are of great importance in descriptions of fishes. The number of the soft rays is expressed by Arabic and that of the spiny rays by Roman numerals: thus, the expression "rays of dorsal fin VI, 12" means that the dorsal fin has 6 spiny and 12 soft rays. Where two dorsal fins are present the number of the rays of the anterior fin is separated from that of the posterior one by a dash. Thus the expression "rays of dorsal

fins XI-III, 5" means that the anterior dorsal fin has 11 spiny rays and the posterior dorsal has 3 spiny and 5 soft rays. In certain groups of soft-rayed fishes, such as the trout, catfish and others, the posterior dorsal fin is a fleshy structure without rays of any kind, and is consequently not mentioned in such descriptions; it is called the *adipose fin*.

**Lateral Line** (Fig. 1).—In most fishes the lateral line appears as a longitudinal series of modified scales extending along the side of the body from the head to the caudal fin. In the lower, soft-rayed fishes it tends to run parallel to the line of the belly, and in the higher, spiny-rayed fishes to the line of the back. In many fishes it is not complete or is altogether wanting, at least so far as any external appearance is concerned.

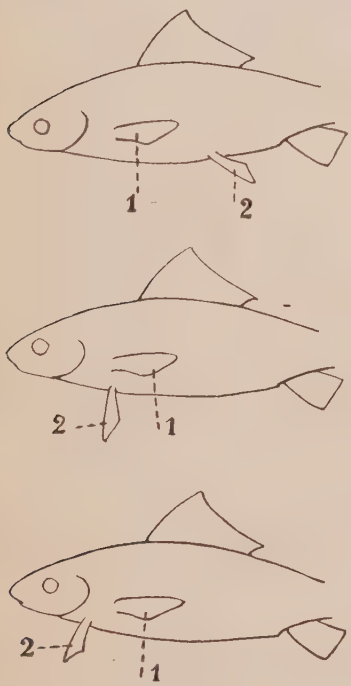


FIG. 3.—Position of the ventral fins: *a*, the ventral fins in an abdominal position; *b*, in a thoracic position; *c*, in a jugular position: 1, pectoral fins; 2, ventral fins (*from Süssw. Fauna Deut.*).

**Scales** (Fig. 5).—In some species of fishes, the catfish for example, the skin is naked and without any hard skeletal covering. In most fishes, however, the skin is protected by a layer of scales, and

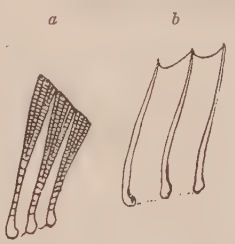


FIG. 4.—Soft fin-rays (*a*); spiny fin-rays (*b*) (*from Süssw. Fauna Deut.*).

in a few groups by bony plates, prickles, or other skeletal structures. By far the greatest number of species have scales of one of two types, the *cycloid* or the *ctenoid scales*. These are thin rounded plates which cover the body more or less completely and are imbricated, that is, arranged in overlapping rows like the shingles on a roof, the free ends being directed backwards. Cycloid scales characterize the more primitive of the bony fishes, as the trout and salmon, and have a smooth margin. Ctenoid scales have a more or less roughened surface and a dentate, serrate or spiny free margin; they characterize the more specialized

bony fishes, as the perch and the bass. In some species both types of scales are present, and in some species scales which are intermediate between the two. Certain ganoid fishes, as the garpike, have *ganoid scales*, which are rhombic in form and are not imbricated, while certain ganoids, as the sturgeon, and certain teleosts, as the sticklebacks, have bony plates on the sides of the body.

In the description of a fish the average number of scales (Fig. 6) occurring in the lateral line between the head and the caudal fin is given. The number, also, occurring in a dorso-ventral series, between the lateral line and the back and the lateral line and the belly, is usually given. Thus the expression "scales 5-46-11" means that 46

FIG. 5.—Scales of fishes: *a*, ctenoid scale (hinder end of scale at the right); *b*, ganoid scales; *c*, cycloid scale (hinder end of scale above) (*modified from Cambridge Natural History and Jordan's Guide to the Study of Fishes*).

scales occur in the lateral line, or if no lateral line is present in a lateral series between the head and the caudal fin, that 5 scales occur in a dorso-ventral series between the forward end of the dorsal fin and the lateral line and 11 scales between the lateral line and the anus or the forward end of the anal fin. These figures are never absolute for all the individuals of a species, but are liable to vary a sixth from the average given.

**Color.**—Fishes are among the brightest of animals. Their colors cover a wide range, and a statement of the markings of a specimen is usually an important part of a description. It must be remembered, however, that there is often a considerable variation in the coloration of a species, that the two sexes are often colored differently, the female being duller than the male, and that bright colors, especially reds and blues, often fade after the death of the animal or when it has lain in a preserving fluid.

**Head** (Fig. 7).—The portion of the head in front of the eyes is the *snout*. The mouth may be either terminal in position, inferior, subinferior or superior, and may also be either horizontal or oblique

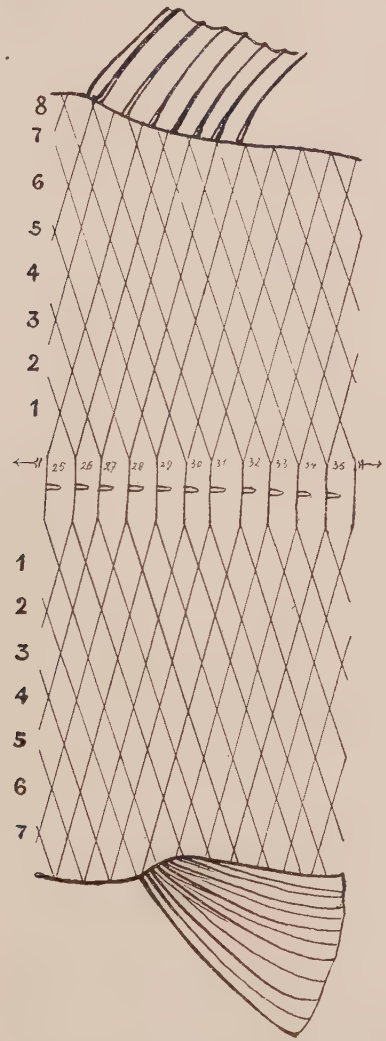


FIG. 6.—A portion of the lateral side of a fish's body between the dorsal fin (above) and the anal fin (below) to illustrate the count of the scales, the lateral line series of which is in the middle, and the dorso-ventral series above and below it (*from Süssw. Fauna Deut.*).

(Fig. 8). The *nostrils* are four in number, two on each side immediately in front of the eye. The upper jaw contains the paired *premaxillary* bones which support its anterior portion, and also the lateral portions as well, and the paired *maxillaries*, which lie above and behind the

lateral portions of the premaxillary, on each side. The premaxillaries are, in many fishes, protractile that is, they can be thrust forward. In certain fishes a *supplementary maxillary* lies above the posterior portion of the maxillary, on each side.

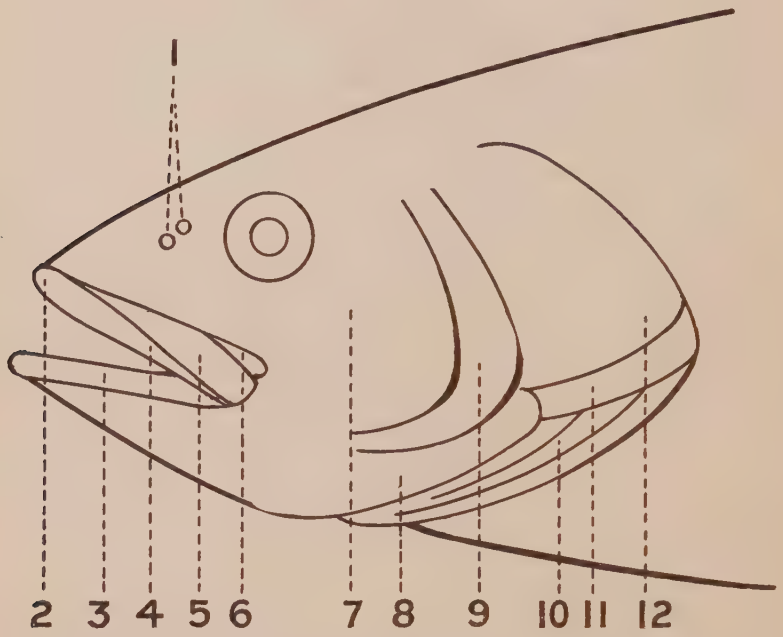


FIG. 7.—Head of a fish: 1, nostrils; 2, premaxillary; 3, mandible; 4, lateral portion of premaxillary; 5, maxillary; 6, supplementary maxillary; 7, cheek; 8, interopercle; 9, preopercle; 10, branchiostegalis; 11, subopercle; 12, opercle.

Many species of fishes, catfish for instance, have one or more pairs of elongated tentacles called *barbels* extending from one or both jaws (Fig. 1).

FIG. 8.—Position of the mouth: *a*, mouth terminal in position; *b*, mouth superior; *c*, mouth inferior (*from Süssw. Fauna Deut.*).

Below and behind the eyes on each side of the head is the *cheek*. Behind the cheek is the *preopercle*, and behind it the *opercle;* beneath them lies the *interopercle* and the *subopercle:* these structures form the

gill-covers. Ventral to them lies the *branchiostegal membrane* supported by the *branchiostegal rays*, or as they are usually called, the *branchiostegals*. The gills lie beneath the gill-covers, borne on four *gill-arches* (Fig. 9): posterior to these arches is a fifth arch which rarely bears gills but is usually massively built and bears teeth; it is called the *pharyngeal arch*. On the inner surface of the opercle near its anterior margin are, in most fishes, small gills called the *pseudobranchiæ*. In most fishes from the pharyngeal margins of each gill-arch a double series of cartilaginous or bony rods project towards the gill-cleft; these are the *gill-*

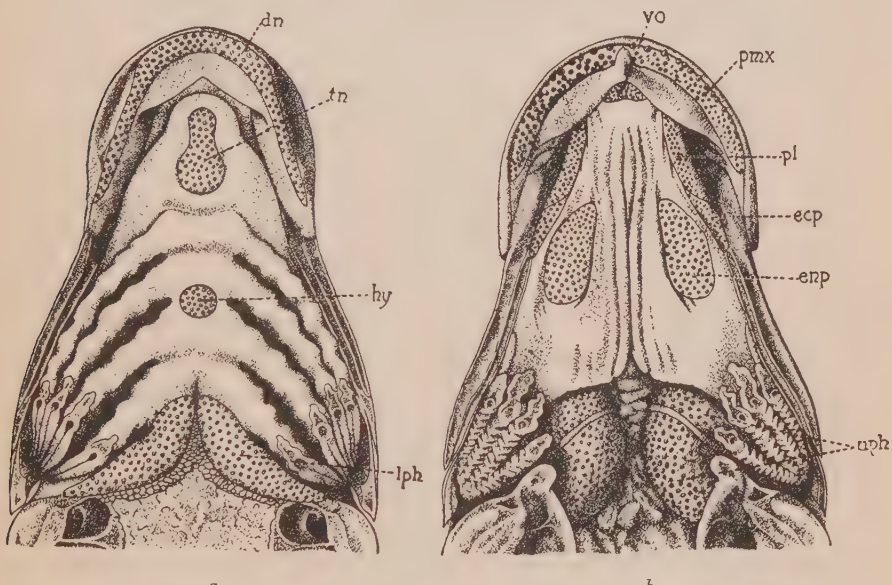


FIG. 9.—The inside of the mouth (of the rock bass, *Ambloplites rupestris*) showing the dentition and the gill-arches: *a*, the floor of the mouth; *b*, the roof of the mouth: *dn*, dentary; *ecp*, ectopterygoid; *enp*, entopterygoid; *hy*, hyoid; *lph*, lower pharyngeal; *pl*, palatine; *pmx*, premaxillary; *tn*, tongue; *uph*, upper pharyngeal; *vo*, vomer (*from Fishes of Illinois*).

*rakers* and they serve as a sieve to prevent particles of food from passing through the gill-clefts with the respiratory water.

**Teeth.**—A few species of fish are without teeth. They are, however, usually present, and may be found, in the various species, on the premaxillaries, dentaries (lower jaw), vomer, palatines, pterygoids, sphenoids, gill-arches, tongue and pharyngeals (Fig. 9). Short, slender, close-set teeth are called *villiform:* long, sharp teeth which project beyond the level of the others are called *canine;* teeth with blunt tips used for crushing shells are called *molar;* flat, mosaic-like teeth are called *paved* or *tessellated;* front teeth with cutting edges are called *incisor*.

**Internal Structures.**—A knowledge of the internal anatomy of a fish is usually not necessary in order to make a systematic description of it. The following features, however, are occasionally referred to in the descriptions in this book: the shape of the stomach; the number and character of the pyloric appendages or cæca of the stomach; the length and character of the intestine; the presence or absence of the air bladder, and its character when present; the character of the four anterior vertebræ, whether they are coössified and have some of their elements detached to form the Weberian ossicles which connect the air bladder with the ear; the unossified portion of the top of the skull in certain fishes known as the fontanelle.

**Key to the Subclasses of Fishes (including the Cyclostomes)**

$a_1$ Mouth without jaws; no paired fins; nostrils median..... 1. *Marsipobranchii.*
$a_2$ Mouth with true jaws; paired fins present; nostrils paired..2. *Pisces.*

**Subclass 1. Marsipobranchii** (*Cyclostomata*).—Fish-like vertebrates with a cylindrical, eel-like body, without scales, paired fins, gill-arches or jaws; skeleton cartilaginous and without ribs; skull imperfectly developed and not separate from the vertebral column; nostril single, median; mouth suctorial; gills sac-like, 6 to 14 in number, opening to the outside through paired pores; no genital ducts, sympathetic nervous system, arterial bulb, pancreas, spleen or air bladder; median fins on posterior half of body: about 20 species, mostly parasitic on fishes in both fresh and salt water, grouped in 2 orders. The first of these orders, with 2 American species, the Californian hagfish, *Polistotrema stouti* (Lockington) and the Atlantic hagfish, *Myxine glutinosa* L., is exclusively marine.

**Key to the Orders of Marsipobranchii**

$a_1$ Gill openings not near head; hagfish, all marine, and not included in this book..... 1. *Hyperotreti.*
$a_2$ Gill openings immediately back of head; lampreys..... 2. *Hyperoartii.*

**Order 2. Hyperoartii.**—The lampreys. Body cylindrical anteriorly, compressed posteriorly; fins median and well developed, the dorsal fin being more or less completely separated by a median notch into two fins; nostril just in front of the eyes and opening into a blind sac which does not communicate with the pharynx; eyes well developed in the adult; mouth suctorial, in the middle of a depressed, funnel-shaped oral plate, called the *buccal funnel* (Fig. 10), which has a fringed margin and is set with sharp, horny teeth or toothlike tubercles; tongue

with sharp rasping teeth; bordering the mouth anteriorly and posteriorly, respectively, are the so-called *supraoral* and *infraoral laminæ*, horny plates each with 2 or more teeth; intestine with spiral valve; 7 pairs of gill-sacs, the external openings forming a row immediately back of the eyes: about 15 species, in fresh and salt water; 1 family, the Petromyzonidæ with about 8 species in the United States.

Adult lampreys, in the case of most of the species, feed by attaching themselves to fishes and sucking their blood and rasping away the flesh, often killing them, and causing large sores and scars on those they do not kill; they are often destructive to fisheries. The marine species ascend the streams to breed. The young animals, which are called *Ammocœtes*, are without functional paired eyes, suctorial mouth or teeth and pass through a metamorphosis; they live in this larval condition two to six years, during which they burrow in muddy bottoms in the streams where they are born, feeding on minute organic particles which the current brings them. Several of the smaller species have apparently a very short adult life; the intestine is degenerate and nonfunctional and the buccal teeth are weak, blunt and more or less obsolescent; such species are probably not parasitic.

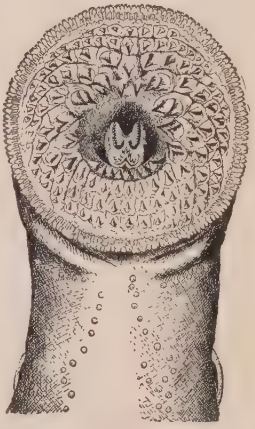

FIG. 10.—Buccal funnel of *Ichthyomyzon unicolor* (*from Jordan's Guide to the Study of Fishes, after Gage*).

**Key to the United States Genera of Petromyzonidæ**

$a_1$ Buccal funnel with numerous teeth which radiate from the mouth in all directions (Fig. 10).
  $b_1$ Dorsal fin continuous; Great Lakes and Mississippi Valley..1. *Ichthyomyzon.*
  $b_2$ Two separated dorsal fins; Atlantic slope.....2. *Petromyzon.*
$a_2$ Buccal funnel with teeth which do not radiate from the mouth but lie in several groups (Fig. 12).
  $b_1$ A posterior row of small teeth connect the posterior pair of enlarged lateral teeth (Fig. 12).....3. *Entosphenus.*
  $b_2$ No such row of teeth present (Fig. 13).....4. *Lampetra.*

**1. Ichthyomyzon** Girard. Small fresh water lampreys with a single dorsal fin which has a broad notch in the middle and is joined with the caudal fin; muscle segments between gill and anus less than 60: 2 species.

*I. concolor* (Kirtland). Silvery lamprey. Length 300 mm.; color silvery; a small dark spot above each gill pore; supraoral lamina with 1

to 4 (usually 2) approximated cusps; buccal funnel, when expanded, much wider than the body, and with a double row of marginal fringes: valleys of the Great Lakes and St. Lawrence River; southward and westward into the Ohio, Missouri and upper Mississippi valleys; common.

*I. unicolor* (DeKay) (Fig. 10). Length 150 mm.; supraoral lamina with 2 separated cusps; buccal funnel, when expanded, not wider than the body, and with weak or obsolescent teeth; intestine degenerate in the adult: basin of the Great Lakes; often abundant.

**2. Petromyzon** L. Marine and fresh water lampreys with 2 separated dorsal fins: several species, 1 in the United States.

*P. marinus* L. Lamprey eel; great sea lamprey (Fig. 11). Length up to 1,000 mm.; color blackish, more or less mottled; buccal funnel large, with strong, pointed teeth, the innermost lateral teeth being

FIG. 11.—*Petromyzon marinus* (*from Jordan's Guide to the Study of Fishes*).

enlarged and usually bicuspid; supraoral lamina with 2 approximated cusps; infraoral lamina with 7 to 9 strong cusps; muscle segments between gills and anus about 70: North Atlantic along the American, European and African coasts; southward to Florida, ascending the streams to breed; common in the interior lakes of New York and Lake Ontario.

**3. Entosphenus** Gill. Marine and fresh water lampreys with 2 separate dorsal fins; teeth in groups, there being a marginal series bordering the edge of the buccal disc, several enlarged teeth on each lateral border of the mouth, a group on the anterior and one on the posterior part of the disc: 3 species, 1 in Mexico.

*E. tridentatus* (Gairdner). Length 450 mm. or more; color dark brown; 4 enlarged lateral teeth on a side, the first and last bicuspid, the middle two tricuspid; infraoral lamina with 4 to 6 cusps; supraoral lamina tricuspid: Pacific Ocean, from Unalaska to southern California, ascending the streams, in the Columbia as far as Walla Walla.

*Subspecies of E. tridentatus*

*E. t. tridentatus* (Gairdner). Muscle segments between gills and anus 68 to 74: Columbia River and northwards.

*E. t. ciliatus* (Ayres). Muscle segments between gills and anus 57 to 67: southern Oregon and southwards.

*E. appendix* (DeKay) (*E. wilderi* Jordan & Evermann) (Fig. 12). Length 200 mm.; color bluish black; enlarged lateral teeth 3 on a side, all bicuspid; infraoral lamina with 8 to 11 cusps; supraoral lamina bicuspid; muscle segments between gills and anus 67 to 73; intestine of adult degenerate: in streams from southern New England to Maryland; westward to Wisconsin and Iowa; northward into Canada; in eastern Asia.

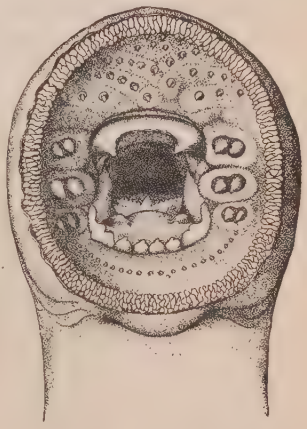

FIG. 12.—Buccal funnel of *Entosphenus appendix* (*from Fishes of Illinois*).

**4. Lampetra** Gray. Teeth very few, there being usually 3 enlarged two-cusped laterals on each side of the mouth; supraoral lamina with 2 separated cusps, joined by a bridge: 3 American species.

*L. fluviatilis* (L). Length 350 mm.; dorsal fins separated; 63 to 70 muscle segments between gills and anus; teeth strong and sharp; infraoral lamina with 6 to 9 cusps; anterior portion of buccal disc with many teeth: coasts and streams of Europe, Asia and western North America from San Francisco to Puget Sound.

*L. planeri* (Block) (*L. cibaria* Girard). Length 200 mm.; color plumbeous; dorsal fins separated only by a notch; teeth weak and blunt; infraoral lamina with 6 to 9 cusps; anterior portion of buccal disc with many teeth; intestine of adult degenerate; 57 to 66 muscle segments between gills and anus: streams of Europe, Japan and western America from Alaska to central California.

*L. lamottenii* (LeSueur) (*L. æpyptera* Abbott) (Fig. 13). Length 120 mm.; teeth much reduced in number and size; infraoral lamina with a crenulated crest and without distinct cusps; lateral teeth sometimes unicuspid and more or less obsolescent; anterior portion of buccal disc with usually 4 teeth; 54 to 60 muscle segments between gills and anus: in the Ohio and Potomac River basins.

**Subclass 2. Pisces.**—The true fishes. Aquatic vertebrates with gills which are attached to bony or cartilaginous gill-arches; with true jaws; with median fins and usually two pairs of paired fins; in most cases with scales; with paired nostrils: 3 divisions.

### Key to the Divisions of Pisces

$a_1$ Skeleton cartilaginous; skull without membrane bones; sharks; skates; (all marine, not included in this book) ..... 1. *Selachii.*
$a_2$ Skeleton in most cases bony; skull with membrane bones.
  $b_1$ Paired fins each with a segmented cartilaginous axis; respiration by gills and lungs (no American species and hence not included in this book) ..... 2. *Dipnoi.*
  $b_2$ Fins supported by fin-rays and without central axes ..... 3. *Teleostomi.*

**Division 3. Teleostomi.**—Skeleton usually bony; skull covered with membrane bones separated by sutures; a single gill opening on each

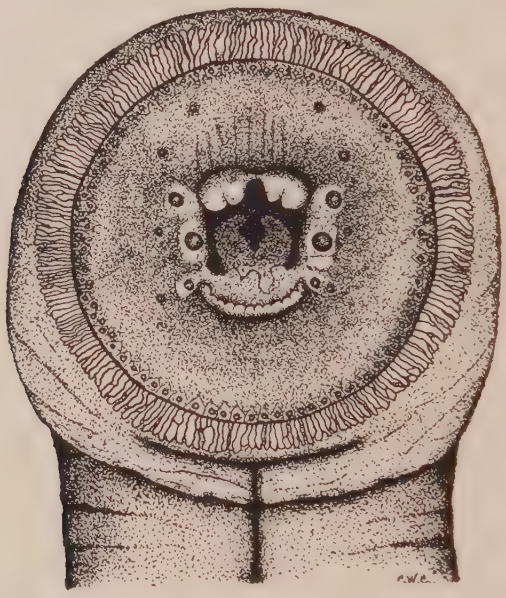

FIG. 13.—Buccal funnel of *Lampetra lamottenii* (*from Creaser & Hobbs*).

side, the gills being supported by 4 pairs of arches in most cases, and covered by the opercles; air bladder mostly present: 2 series.

### Key to the Series of Teleostomi

$a_1$ Skeleton cartilaginous or bony ..... 1. *Ganoidea.*
$a_2$ Skeleton bony ..... 2. *Teleostei.*

**Series 1. Ganoidea.**—The ganoid fishes. Fishes with either cartilaginous or bony skeleton; with heterocercal or homocercal caudal fin; with either ganoid or cycloid scales or bony dermal plates; with an air

bladder provided with an open duct connecting it with the pharynx or the œsophagus; with an arterial bulb with several pairs of valves; and with an intestinal spiral valve: 3 orders, with about 13 American species.

**Key to the Orders of Ganoidea**

$a_1$ Ganoids represented in Africa by the genus *Polypterus* but not in America and not included in this book.....1. *Crossopterygii.*
$a_2$ Ganoids without scales, with the body either naked or with bony plates.....2. *Chondrostei.*
$a_3$ Ganoids with the body covered either with ganoid or cycloid scales.....3. *Holostei.*

**Order 2. Chondrostei.**—Cartilaginous ganoids. Fish of large size and with the skeleton mostly and the vertebral column entirely cartilaginous; notochord persistent; opercles usually large; branchiostegal rays weak or wanting; mouth ventral beneath a long snout; body naked or with bony plates; tail heterocercal: 2 families, with 8 American species.

**Key to the Families of Chondrostei**

$a_1$ Body naked.....1. *Polyodontidæ.*
$a_2$ Body more or less covered with bony plates; sturgeons.....2. *Acipenseridæ.*

**Family 1. Polyodontidæ.**—The paddle-fishes. Body without scales and smooth; snout spatulate and very long; teeth minute, present only in the young; opercles rudimentary, prolonged behind on each side to form a long flap; spiracle present; 1 branchiostegal ray; air bladder cellular: 2 species and genera, 1 in China (*Psephurus gladius*).

**Polyodon** Lacépède. Gill-rakers very fine and numerous: 1 species.

*P. spathula* (Walbaum). Spoonbill; paddle-fish. Extreme length 1,800 mm.; extreme weight 150 lbs.; color olivaceous; head, with opercle, more than half the length of the body; spatula one-third the total length: Mississippi Valley; French Broad, North Carolina; often common in the larger streams and lakes, where it feeds on small organisms in the mud; used for food and the roe made into caviar.

**Family 2. Acipenseridæ.**—Sturgeons. Large fish with 5 longitudinal rows of keeled bony plates on the body, a middorsal series and a lateral and an abdominal series on each side, between which are small plates or granules; mouth ventral and toothless, in front of which projects a long snout; 4 barbels in a transverse row in front of the mouth; gill-slits 4, with an accessory opercular gill; no branchiostegal rays; ventral fins posterior; median fins with spine-like projections called fulcra: about 20 species; 7 species and 3 genera in America.

### Key to the Genera of Acipenseridæ

$a_1$ Spiracles present.....1. *Acipenser.*
$a_2$ Spiracles absent.
  $b_1$ Belly covered with subrhombic plates.....2. *Scaphirhynchus.*
  $b_2$ Belly naked.....3. *Parascaphirhynchus.*

**1. Acipenser** L. Snout subconical; a small spiracle above the eye; tail subcylindrical and not mailed; pseudobranchiæ present: cosmopolitan, in northern waters, both fresh and salt; 5 species in America; the marine species ascend the rivers to breed; the flesh is used for food, the eggs are made into caviar and the air bladder into isinglass; the food of sturgeons consists of small fishes, crayfish, snails, etc.

### Key to the American Species of Acipenser

$a_1$ In the eastern and central States.
  $b_1$ In the Atlantic Ocean and its tributaries.
    $c_1$ Space between dorsal and lateral plates with 5 to 10 rows of small plates.....*A. sturio.*
    $c_2$ Space between dorsal and lateral plates with very many series of minute plates.....*A. brevirostrum.*
  $b_2$ In the Great Lakes and upper Mississippi Valley.....*A. rubicundus.*
$a_2$ On the Pacific slope.
  $b_1$ Lateral plates about 44.....*A. transmontanus.*
  $b_2$ Lateral plates 26 to 30.....*A. medirostris.*

*A. sturio* L. (*A. oxyrhynchus* Mitchill.) Common sturgeon. Extreme length 3,600 mm.; extreme weight 550 lbs.; head 3.5; depth 5.75; color olive gray, lighter below; dorsal plates 10 to 14; laterals 27 to 29; ventrals 8 to 11; rays of dorsal fin 38; anal 27; snout long and sharp, almost as long as the head: Atlantic Ocean and its tributary streams from Maine to South Carolina; often common; a valuable food fish; northern Europe.

*A. brevirostrum* LeSueur. Short-nosed sturgeon. Length 800 mm.; head 4; depth 5.5; color dusky; snout very short, about a quarter the length of the head; dorsal plates 8 to 11; laterals 22 to 33; ventrals 6 to 9; rays of dorsal fin 41; anal 22: Cape Cod to Florida; not common.

*A. rubicundus* LeSueur. Lake sturgeon (Fig. 14). Length 1,800 mm.; head 3.5; depth 5.75; average weight 50 lbs.; extreme weight 100 lbs.; color dark olive, often with large irregular blackish spots; sides paler or reddish; dorsal plates 11 to 15; laterals 38; ventrals 10; rays of dorsal fin 35; anal 26; plates large and rough in the young, becoming smoother and often lost with age: basin of the Great Lakes

and the Mississippi Valley and northwards; abundant; the largest fish in these regions.

*A. transmontanus* Richardson. White sturgeon. Length 1,500 mm.; head 4; depth 7; weight 125 lbs.; record length 4,000 mm.; record weight 1,000 lbs.; color dark gray; dorsal plates 11; laterals 44; ventrals 10 to 12; rays of dorsal fin 45; anal 28: Pacific Ocean from Alaska to Monterey, ascending the streams, in which it may remain throughout the year.

*A. medirostris* Ayres. Green sturgeon. Length 2,000 mm.; head 4.25; depth 7.5; weight 350 lbs.; color olive green, with a midventral stripe and one on each side above the ventral plates; dorsal plates 10; laterals 26 to 30; ventrals 7 to 10; rays of dorsal fin 35; anal 28: Pacific Ocean from San Francisco northwards, ascending the streams; not used for food.

**2. Scaphirhynchus** Heckel. Snout broad and shovel-shaped; spiracles absent; caudal peduncle slender, long and flattened, and covered

FIG. 14.—*Acipenser rubicundus* (*from Jordan & Evermann*).

with bony plates; pseudobranchiæ absent; tail ending in a long filament; ribs 10 or 11: 1 species.

*S. platorhynchus* (Rafinesque). Shovel-nosed sturgeon. Length 1,200 mm.; head 4; depth 8; weight 9 lbs.; color pale olive; dorsal plates 17 or 18; laterals 41 to 46; ventrals 11 to 13; rays of dorsal fin 32; anal 20: upper and middle Mississippi Valley; common.

**3. Parascaphirhynchus** Forbes and Richardson. Like *Scaphirhynchus* but with the belly naked; ribs 20 or 21: 1 species.

*P. albus* F. and R. White sturgeon. Length 1,000 mm.; weight 5 lbs.; color very light gray or white; dorsal plates 16 to 19; laterals 41 to 47; ventrals 10 to 13; rays of dorsal fin 35 to 43; anal 20 to 23: Mississippi and Missouri Rivers; rare.

**Order 3. Holostei.**—The bony ganoids. Skeleton bony; branchiostegals present; mouth terminal and with teeth; body covered with ganoid or cycloid scales; tail heterocercal; air bladder cellular and lung-like and connected by a sort of glottis with the œsophagus: 2 families, with 5 American species.

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### Key to the Families of Holostei

a$_1$ Body covered with ganoid scales.....1. *Lepisosteidæ.*
a$_2$ Body covered with cycloid scales.....2. *Amiidæ.*

**Family 1. Lepisosteidæ.**—The garpikes. Body elongate and subcylindrical, with rhombic ganoid scales; jaws elongate, forming a long slender snout, the upper jaw of which is composed mostly of the premaxillaries; opercle supporting an accessory gill; branchiostegals 3; spiracles absent; spiral valve rudimentary; rays of both dorsal and anal fins 8: 1 genus.

**Lepisosteus** Lacépède (*Lepidosteus* Agassiz). With the characters of the family: about 4 species in the fresh waters of North America, one of which (*L. tropicus* Gill) is in Central America; flesh usually not used for food, except in the southern States.

### Key to the United States Species of Lepisosteus

a$_1$ Snout more than twice as long as rest of head.....*L. osseus.*
a$_2$ Snout about as long as rest of head.
b$_1$ A single row of large teeth on each side of upper jaw.....*L. platostomus.*
b$_2$ Two rows of large teeth on each side of upper jaw.....*L. tristœchus.*

*L. osseus* (L.). Common garpike. Length 1,300 mm.; head 3; depth 10 to 13; color olivaceous, silvery below; hinder parts with black spots; very young animals with a black lateral band; scales in lateral line about 62: Great Lakes and Mississippi Valley to the Rio Grande; Atlantic and Gulf slope from Vermont southwards; in rivers and lakes, sometimes entering the sea; common.

*L. platostomus* Rafinesque. Short-nosed gar. Length 900 mm.; head 3 to 3.9; depth 8 to 10; color olivaceous, but darker than *L. osseus;* scales in lateral line 56: Great Lakes and Mississippi Valley to Rio Grande; common; more so southwards.

*L. tristœchus* (Block and Schneider). Alligator gar (Fig. 15). Length up to 6,000 mm.; head 3.7; depth 8; color greenish, paler below; scales in lateral line 60: southern States, north to the Ohio and Illinois Rivers.

**Family 2. Amiidæ.**—The bowfins. Body fusiform, compressed, with cycloid, imbricated scales; head subconical, covered with a hard bony helmet; snout short; branchiostegals 10 or 12; no opercular gill or pseudobranchiæ; dorsal fin very long; tail convex behind, somewhat heterocercal; lateral line present: 1 genus.

**Amia** L. (*Amiatus* Rafinesque). With the characters of the family: 1 species.

*A. calva* L. Dogfish; bowfin (Fig. 16). Length 450 to 600 mm.; head 3.7; depth 4 to 4.5; color dark olive or blackish, with traces of dark reticulate markings on the sides; paler below; male with a round black spot edged with orange at the base of the tail; dorsal fin with

FIG. 15.—*Lepisosteus tristœchus* (*Jordan & Evermann*).

48 rays; anal 10 to 12; scales 67: eastern and central States, southward to Florida and Texas; northward to Vermont and Minnesota; common; in lakes and sluggish waters; not used for food. The eggs are deposited in a nest formed by the male in a gravelly or sandy bottom, who then guards them and also the young after they are hatched.

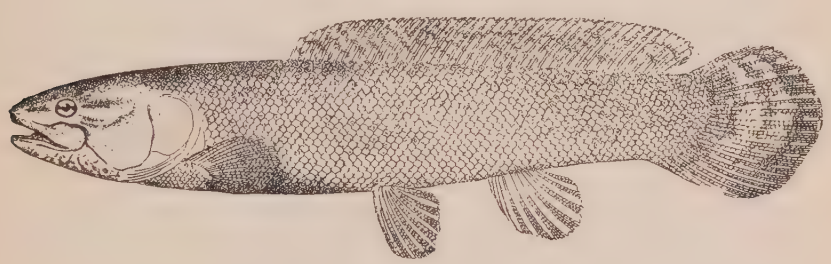


FIG. 16.—*Amia calva* (*Jordan & Evermann*).

**Series 2. Teleostei.**—The bony fishes. Fishes with a bony skeleton and with usually a homocercal, never a heterocercal, tail; scales cycloid or ctenoid, or wanting; opercles present; air bladder usually present, but without cells and usually with a more or less rudimentary pneumatic duct, or none; without spiral valve; arterial bulb with a single pair of valves: many orders; 8 orders in the fresh waters of the United States.

### Key to these Orders of Teleostei

$a_1$ Ventral fins abdominal (Fig. 3) in position (in the eels absent); no spinous rays in the fins (except in the catfish).

$b_1$ Head not scaly.

$c_1$ Body covered with scales (in the eels imbedded and hidden).

$d_1$ Ventral fins present.
$e_1$ Branchiostegal rays 6 or more.....1. *Isospondyli.*
$e_2$ Branchiostegal rays 3.
$f_1$ Pseudobranchiæ present (rarely absent).....3. *Eventognathi.*
$f_2$ Pseudobranchiæ absent (but one species in United States).....4. *Heterognathi.*
$d_2$ Ventral fins absent; eels.....2. *Apodes.*
$c_2$ Body without scales; dorsal and pectoral fins each with a strong spine; catfish.....5. *Nematognathi.*
$b_2$ Head more or less scaly.
$c_1$ Lateral line absent or, when present, median in position.6. *Haplomi.*
$c_2$ Lateral line extends along the side of the abdomen (but one species in United States).....7. *Synentognathi.*
$a_2$ Ventral fins mostly thoracic or jugular (Fig. 3), typically with 1 spinous and 5 soft rays each; anterior rays of dorsal, anal and pectoral fins usually spinous.....8. *Acanthopteri.*

**Order 1. Isospondyli.**—Herring; salmon; trout. Fishes with unmodified anterior vertebræ; lower pharyngeal arch simple, not falciform; head not scaly; maxillary distinct from the premaxillaries and forming part of the margin of the upper jaw; no barbels; air bladder, if present, with a pneumatic duct; fins without spines; ventral fins abdominal; scales usually cycloid, sometimes ctenoid, occasionally wanting: 20 to 25 families, mostly marine; 6 families in fresh water.

**Key to the Fresh Water Families of Isospondyli**

$a_1$ No adipose fin present.
$b_1$ Lateral line present.....1. *Hiodontidæ.*
$b_2$ Lateral line absent.
$c_1$ Last rays of dorsal fin much elongated.....2. *Dorosomidæ.*
$c_2$ Dorsal fin normal.....3. *Clupeidæ.*
$a_2$ Adipose fin present.
$b_1$ Branchiostegals 10 to 20.....4. *Salmonidæ.*
$b_2$ Branchiostegals 6 to 10.
$c_1$ Dorsal fin very long.....5. *Thymallidæ.*
$c_2$ Dorsal fin short.....6. *Argentinidæ.*

**Family 1. Hiodontidæ.**—The mooneyes. Body oblong, compressed, covered with silvery cycloid scales, short; mouth terminal, oblique; tail forked; branchiostegals 8 to 10; lateral line present; teeth on jaws, margin of the tongue, vomer, sphenoid, hyoid, pterygoid and palatines; eyes very large; no pseudobranchiæ; 1 pyloric appendage: 1 genus.

**Hiodon** LeSueur. With the characteristics of the family: 3 species, all of little food value.

**Key to the Species of Hiodon**

$a_1$ Dorsal fin with 9 rays..... *H. alosoides.*
$a_2$ Dorsal fin with 12 rays.
  $b_1$ In the north-central States..... *H. tergisus.*
  $b_2$ In the southeastern States..... *H. selenops.*

*H. alosoides.* (Rafinesque). Mooneye. Length 300 mm.; head 4.5; depth 3.5; color bluish; sides silvery, with a golden lustre; rays of dorsal fin 9; anal 32; scales 6-56-7; belly in front of ventrals carinated: Ohio River basin and Great Lakes region to the Saskatchewan; common northwards.

*H. tergisus* LeSueur (Fig. 17). Mooneye; silver bass. Length 300 mm.; head 4.3; depth 3; color olivaceous with silvery sides; rays of dorsal fin 12; anal 28; scales 5-55-7; belly behind ventrals somewhat

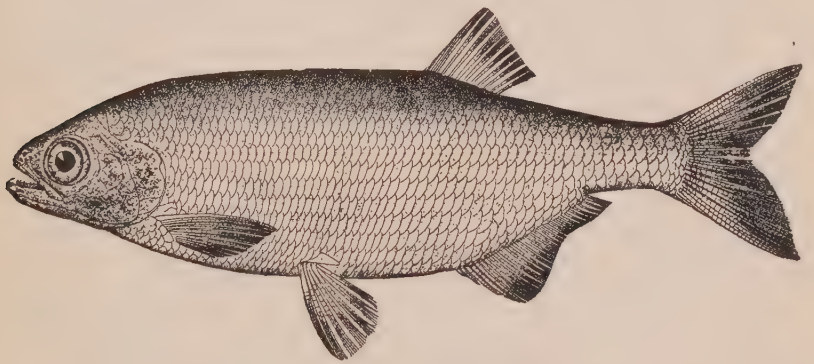


FIG. 17.—*Hiodon tergisus* (*Jordan & Evermann*).

carinated: basin of the Ohio River; Lake Erie to the Lake of the Woods and Montana; common in large streams.

*H. selenops* Jordan & Bean. Body elongate; length 300 mm.; head 4.1; depth 4; color clear silvery; rays of dorsal fin 12; anal 27; scales 50: Tennessee, Cumberland and Alabama Rivers; rare.

**Family 2. Dorosomidæ.**—Body short and deep, strongly compressed; scales cycloid; belly carinated; no lateral line; mouth toothless, small; branchiostegals 6; pseudobranchiæ large; eyelid adipose; anal fin very long and low; tail forked: 1 genus.

**Dorosoma** Rafinesque. With the characters of the family: 10 species of mud-feeding fishes, in warm seas and rivers; 1 in the United States.

*D. cepedianum* (LeSueur). Gizzard shad; mud shad. Length 375 mm.; head 4.3; depth 2.5; color silvery, being bluish above; rays of dorsal fin 12, its posterior ray very long and extending back half

the distance to the tail; rays of anal fin 31; scales 56-23; stomach like a fowl's gizzard: Cape Cod to Mexico, in the sea and ascending the rivers; Mississippi Valley; introduced into Lakes Erie and Michigan and in ponds from New Jersey to Texas; common; of little food value.

**Family 3. Clupeidæ.**—Herring; shad. Body oblong or elongate, covered with cycloid scales; mouth large and terminal; teeth feeble or wanting; maxillaries formed of 2 or 3 pieces and forming side of upper jaw; pseudobranchiæ 6 to 15; no lateral line; branchiostegals 6 to 15; tail forked: about 30 genera and 150 species, mostly marine, inhabiting all seas; a few species live in fresh water and several marine ones enter streams to spawn. A number of marine species, such as the common herring, *Clupea harengus* L., the alewife, *Pomolobus pseudoharengus* (Wilson), the shad, *Alosa sapidissima* (Wil.), the European sardine *Clupanodon pilchardus* (Walbaum) and the menhaden, *Brevoortia tyrannus* (Latrobe), swim in large, often immense. schools, and are very important food fish.

**Key to the Fresh Water Genera of Clupeidæ**

$a_1$ Jaws with teeth.....1. *Pomolobus.*
$a_2$ Jaws toothless.....2. *Alosa.*

1. **Pomolobus** Rafinesque. Body elliptical, compressed; scales cycloid; teeth feeble: many species, mostly in northern seas.

*P. chrysochloris* Raf. Skipjack. Length 375 mm.; head 3.75; depth 3.75; color brilliant blue above; sides silvery, with golden reflections; rays of dorsal fin 16; anal 18; scales 52; lower jaw projecting: Mississippi Valley and Gulf of Mexico; common in the larger streams; introduced into Lake Erie and Michigan; of no food value.

*P. pseudoharengus* (Wilson). Alewife. Length 375 mm.; head 4.6; depth 3.3; color bluish above, with silvery sides; a small black spot behind the opercle; rays of dorsal fin 16; anal 19; scales 50: Atlantic Ocean, south to South Carolina, entering the streams to spawn; in Lake Ontario and the lakes of central New York; very common.

2. **Alosa** Cuvier. Body elliptical, compressed; jaws toothless; upper jaw with a deep notch at the tip: 3 American species.

*A. sapidissima* (Wilson). Shad. Length 750 mm.; head 4.25; depth 3; color bluish above; sides silvery; a dark spot, or a row of several, behind the opercle; gill-rakers 60, very long and slender; rays of dorsal fin 15; anal 21; scales 60: Atlantic Ocean, Newfoundland to the Gulf of Mexico, ascending the streams to spawn; common; introduced into the Pacific Ocean, and very common from San Diego to Fort Wrangel; the most valuable food fish in the eastern States.

*A. alabamæ* Jordan & Evermann. Length 375 mm.; head 4.6; depth 3; color like *A. sapidissima;* rays of dorsal fin 15; anal 20; scales 55: streams entering the Gulf of Mexico.

*A. ohiensis* Evermann. Length 375 mm.; head 4.5; depth 3.6; body very long and slender and compressed; rays of dorsal fin 18; anal 18: Ohio River at Louisville; rare.

**Family 4. Salmonidæ.**—Whitefish; salmon; trout. Body elongate, more or less elliptical, covered with cycloid scales; mouth terminal; maxillary, with supplementary maxillary, forming the side of the upper jaw; tail forked; pseudobranchiæ present; no barbels; lateral line present; air bladder large; pyloric cæca very numerous; posterior dorsal fin adipose; tailfin forked: 10 genera and about 70 species, grouped in 2 subfamilies, which live in the northern latitudes of the New and Old World, mostly in fresh water; many of the marine species ascend the streams to spawn; the family includes many of the most important food and game fishes.

**Key to the Subfamilies of Salmonidæ**

$a_1$ Mouth small; upper jaw extending to the eye (Fig. 18).....1. *Coregoninæ.*
$a_2$ Mouth large; upper jaw extending back of the eye (Fig. 21).....2. *Salmoninæ.*

**Subfamily 1. Coregoninæ.**—Mouth usually small; the maxillary extending to a point in front of or beneath the anterior border of the eye; dentition feeble; flesh white: 3 genera, 1 in Arctic America, in lakes and rivers.

**Key to the Genera of Coregoninæ in the United States**

$a_1$ Lower jaw shorter than the upper; premaxillaries broad, with the cutting edge vertical or directed backwards.....1. *Coregonus.*
$a_2$ Lower jaw usually longer than the upper; premaxillaries with the cutting edge horizontal or directed forwards.....2. *Leucichthys.*

**1. Coregonus** L. Whitefish. Body elongate, compressed; head small; mouth small; teeth minute or wanting; pseudobranchiæ large; air bladder very large: 18 species, in clear lakes in the northern hemisphere, those in Arctic America descending to the sea; 6 species in the United States.

**Key to the Species of Coregonus in the United States**

$a_1$ Species in the eastern and central States.
  $b_1$ Upper jaw reaching beyond the front margin of the eye.
    $c_1$ Body not tuberculated; in the Great Lakes and northwards.....*C. clupeaformis.*

$c_2$ Body of male and many females covered with white tubercules; in Maine.....*C. stanleyi.*
$b_2$ Upper jaw not reaching the eye.....*C. quadrilateralis.*
$a_2$ Species in the far-west.
$b_1$ Adipose fin with a much shorter base than the anal.
$c_1$ Scales 63 in the lateral line.....*C. coulteri.*
$c_2$ Scales 83 in the lateral line.....*C. williamsoni.*
$b_2$ Adipose fin with as long a base as the anal.....*C. oregonus.*

*C. clupeaformis* (Mitchill) (Fig. 18). Common whitefish. Length 600 mm. or more; greatest weight about 23 lbs.; head 4.5 to 5; depth 3.5 to 4; color olivaceous above; sides white; rays of dorsal fin 10 to 12; anal 10 to 14; scales 72 to 86, usually over 75; branchiostegals 9 to 10; gill rakers long and slender: Great Lakes and neighboring waters, and northward to the Arctic Ocean; abundant; the most valuable food fish in the Great Lakes. The whitefish feeds on small crustaceans and mollusks

FIG. 18.—*Coregonus clupeaformis (from Jordan & Evermann).*

and lives most of the year in deep water, but in the fall and early winter, at spawning time, it approaches the shores.

*C. stanleyi* Kendall. Length 230 mm.; head 4.5; depth 4.3; color of back blue-black; sides and belly yellowish; body of male and of many females covered with white tubercles; rays of dorsal fin 10; anal 11; scales 10-82-7: lakes of Maine; abundant.

*C. quadrilateralis* Richardson. Menominee whitefish; frostfish. Length 300 mm.; head 5.5; depth 4.5; color dark bluish above; silvery beneath; rays of dorsal fin 11; anal 12; scales 8-90-7; branchiostegals 8; gill-rakers short and stout; body slender and elongate: the upper Great Lakes and northward; lakes of the Adirondack region and of New England; common.

*C. williamsoni* Girard. Rocky Mountain whitefish. Length 400 mm.; head 4.5 to 5; depth 4 to 5; color bluish above; sides silvery; fins

tipped with black; rays of dorsal and anal fins 10 to 13; scales 8 to 10-78 to 88-7 or 8; body elliptical, but little compressed; head short, conic: from western Montana into Washington and Oregon; southward in Nevada to the Truckee; common in clear streams and lakes.

*C. coulteri* Eigenmann & Eigenmann. Length 200 mm.; color dull silvery; rays of dorsal and anal fins 10 to 11; scales 8-60 to 63-6; body heavy; snout blunt: head waters of the Columbia; rare.

*C. oregonus* Jordan & Snyder. Chisel-mouth jack. Length 425 mm.; head 4; depth 5; color silvery; rays of dorsal and anal fins 12; scales 9-86-6; body long and slender; snout very long, with a fleshy tip; adipose fin very large: basin of the Columbia; common.

**2. Leucichthys** Dybowski. Ciscoes; lake herrings. Similar to *Coregonus* but differing from it in having a larger mouth and longer jaws, the premaxillaries being horizontal in position and the lower jaw usually more or less projecting; gill-rakers very long and slender; jaws toothless: numerous species, in the northern hemisphere, 14 in the United States, 3 in Arctic America; all valuable food fishes.

### Key to the Species of Leucichthys in the United States

$a_1$ Body elongate, herring-shaped; minute teeth on tongue.
  $b_1$ Shallow-water species, spawning in late autumn; fins pale in color; maxillary not reaching past middle of the eye.
    $c_1$ Adipose fin very small, usually shorter than the eye.
      $d_1$ Lower jaw not projecting; in the upper Great Lakes. . *L. harengus.*
      $d_2$ Lower jaw projecting; in New York State. . . . . *L. osmeriformis.*
    $c_2$ Adipose fin longer than the eye.
      $d_1$ Body elongate, the depth being 4 to 4.5.
        $e_1$ Depth 4.5; in Lakes Huron and Michigan and small neighboring lakes. . . . . *L. sisco.*
        $e_2$ Depth 4; in Lakes Ontario and Cayuga. . . . . *L. ontariensis.*
      $d_2$ Body robust, the depth being usually under 4.
        $e_1$ Depth 3.5 to 4. . . . . *L. artedi.*
        $e_2$ Depth 3.5. . . . . *L. eriensis.*
  $b_2$ Deep-water species, spawning in midsummer.
    $c_1$ Maxillary not extending to middle of eye; premaxillaries nearly horizontal.
      $d_1$ Lower jaw projecting; fins with little dark color.
        $e_1$ Head 4.6; in Lake Superior. . . . . *L. supernas.*
        $e_2$ Head 4 to 4.25; in Lakes Ontario, Huron and Michigan. . . . . *L. prognathus.*
      $d_2$ Lower jaw not projecting; fins dark in color.
        $e_1$ In Lake Superior. . . . . *L. nigripinnis.*
        $e_2$ In Lake Michigan. . . . . *L. cyanopterus.*

$c_2$ Maxillary extending to middle of eye.
$d_1$ Scales about 70; in Lake Michigan.....*L. hoyi.*
$d_2$ Scales about 77; in Lake Superior.....*L. zenithicus.*
$a_2$ Body short, deep, compressed; no teeth; colors dark.
$b_1$ Depth 3.2; adipose fin very small.....*L. manitoulinus.*
$b_2$ Depth 2.5 to 3; adipose fin large, longer than the eye.....*L. tullibee.*

*L. harengus* (Richardson). Length 300 mm.; head 4.3; depth 4.5; body elongate; color dark bluish above; silvery on the sides; rays of dorsal fin 11; anal 12; scales 10-83-9; adipose fin very small: shallow waters of Lake Huron and Michigan; very abundant.

*L. osmeriformis* (H. M. Smith) Smelt. Length 250 mm.; head 4; depth 5 or 6; color grayish above; sides bright silvery; rays of dorsal fin 9; anal 13; scales 9-83-10; body elongate and slender; mouth large, with teeth on tongue; adipose fin very small: in lakes of central New York.

*L. sisco* (Jordan). Cisco. Length 250 mm.; head 4.3 to 5; depth 4.1; color deep blue above, changing to silvery below the lateral line; back dotted with black; rays of dorsal fin 9 to 10; anal 12; scales 77; body elongate: in small lakes of northern Indiana and southern Wisconsin.

*L. huronis* (Jordan & Evermann). Blueback. Length 300 mm.; head 4.6; depth 4.2; rays of dorsal fin 10 or 11; anal 11 or 12; scales 75 to 85; body very elongate, elliptical: Lakes Huron and Michigan, occasionally in Lake Erie; common.

*L. ontariensis* J. & E. Length 300 mm.; head 4.5; depth 4; color dark blue above, silvery on the sides; rays of dorsal fin 10; anal 11; scales 9-76-8; body elongate, elliptical: Lakes Ontario and Cayuga; common.

*L. artedi* (LeSueur). Common lake herring. Length 300 mm.; head 4.5; depth 3 to 4; color gray or greenish; sides silvery; rays of dorsal fin 10; anal 12; scales 8-69 to 75-7; body elliptical; head long, compressed and pointed: Lakes Erie and Ontario, and neighboring small lakes; very abundant, occurring along the shores in immense schools; the most important of the lake herrings commercially.

*L. eriensis* (J. & E.). Jumbo herring. Length 450 mm.; head 4.4; depth 3.4; color dark above, without blue shades; rays of dorsal and anal fins 11; scales 71; body very deep and robust: Lake Erie, especially in the northern portion, occasionally in Lake Huron; abundant; the best of the lake herrings as a food fish.

*L. supernas* J. & E. Head 4.4; depth 4; color silvery; rays of dorsal fin 10; anal 12; scales 8-76-7; lower jaw projecting: Lake Superior, in deep water.

*L. prognathus* (H. M. Smith). Long-jaw. Length 375 mm.; head 4.3; depth 3.5 to 4; color dusky above; sides silvery; rays of dorsal fin 9 or 10; anal 10 to 12; scales 9-75-8; body thick; back elevated; mouth large; mandible projecting and very long, reaching to the hinder margin of the eye or beyond: Lake Ontario and other Great Lakes, in deep water; spawning in the summer.

*L. nigripinnis* (Gill). Bluefin; blackfin. Length 450 mm.; head and depth 4; color dark bluish above; sides silvery, with dark dots; fins black; rays of dorsal fin 11; anal 12; scales 8-75-8; body elliptical;

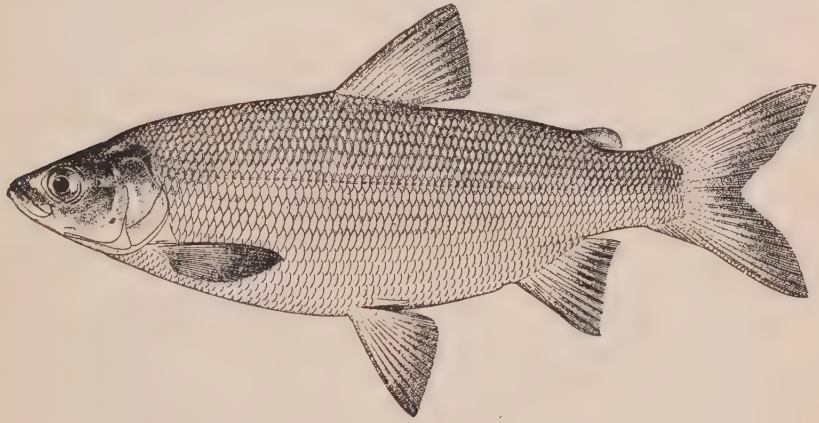


FIG. 19.—*Leucichthys tullibee (from Jordan & Evermann's Salmonoid Fishes of the Great Lakes).*

mouth large: Lake Michigan, and small lakes of Wisconsin and Minnesota, in deep water; common.

*L. cyanopterus* J. & E. Length 320 mm.; head 4; depth 3.75; color silvery, bluish above; rays of dorsal fin 10 or 11; anal 11 or 12; scales 8-76 to 87-7: Lake Superior, in deep water.

*L. hoyi* (Gill). Cisco. Length 325 mm.; head and depth 4; color bluish above; sides silvery; rays of dorsal fin 10; anal 11 or 12; scales 7-73-7; body slender; pseudobranchiæ very large: Lake Michigan, in deep water; locally abundant.

*L. zenithicus* (J. & E.). Long-jaw. Length 250 mm.; head 3.8 to 4; depth 4 to 4.75; color blue above, silvery on the sides; rays of dorsal fin 10 or 11; anal 11 or 12; scales 8-77 to 83-7: Lake Superior, in deep water.

*L. manitoulinus* J. & E. Head 4; depth 3.4; color dark above the lateral line, silvery below; fins blackish; rays of dorsal fin 12; anal 13; scales 8-71-8; adipose fin very small: North Channel of Lake Huron; abundant.

*L. tullibee* (Rich.). Tullibee (Fig. 19). Length 450 mm.; head 4; depth 3; color bluish above; sides white with fine dots; rays of dorsal and anal fins 12; scales 8 or 9-67 to 74-8; body short, very deep, compressed; adipose fin large: basin of Lake Winnipeg; small lakes of Minnesota and Wisconsin; Lakes of central New York; common.

**Subfamily 2. Salmoninæ.**—Salmon and trout. Mouth large, the maxillary extending to a point behind the eye; dentition strong and complete, teeth occurring on the jaws, vomer, palatines and tongue; scales small; flesh usually pink or orange in color: 4 genera in the United States.

**Key to Genera of Salmoninæ in the United States**

$a_1$ Anal fin with 13 to 17 rays; Pacific salmon.....1. *Oncorhynchus.*
$a_2$ Anal fin with from 9 to 12 rays.
  $b_1$ Body not spotted with red.
    $c_1$ Body spotted with black.....2. *Salmo.*
    $c_2$ Body spotted with gray.....3. *Cristivomer.*
  $b_2$ Body spotted with red.....4. *Salvelinus.*

1. **Oncorhynchus** Suckley. Pacific salmon. Body elongate, compressed, elliptical; mouth wide; during the breeding season, in the fall, the snout of the male becomes distorted, both upper and lower jaw being elongated, the former hooking over the latter, which is itself hooked at the tip, the teeth become enormously enlarged, a fleshy hump develops in front of the dorsal fin, and the flesh loses its pink color more or less completely: 5 species; north Pacific Ocean, ascending the rivers of both America and Asia to spawn; the most valuable commercial fishes in the country. The king salmon and blueback begin their run up the streams generally the last of March and continue it until the spawning season in the fall; the other species run only in the fall. The spring and summer are when the most valuable catches are made and when the fish are in the best condition. The fall catches are of far less commercial value as the flesh of the fishes is then poor, dry and colorless. The fish do not feed during the run, and most of them probably die after spawning. The young salmon descend the stream to the sea where they feed for a period of years, which for the king salmon is from 3 to 5 years, before arriving at maturity, when they migrate to the spawning grounds.

**Key to the American Species of Oncorhynchus**

$a_1$ Gill-rakers short and comparatively few (20 to 25 in number);
  $b_1$ Tail with large oblong spots; scales very small.....*O. gorbuscha.*

$b_2$ Tail without large oblong spots.
$c_1$ Rays of dorsal fin 9; branchiostegals 13 or 14.....*O. keta.*
$c_2$ Rays of dorsal fin 11; branchiostegals 15 to 19.....*O. tschawytscha.*
$c_3$ Rays of dorsal fin 10; branchiostegals 13 or 14.....*O. kisutch.*
$a_2$ Gill-rakers long and 30 to 40 in number.....*O. nerka.*

*O. gorbuscha* (Walbaum). Humpback salmon. Weight up to 6 lbs.; color bluish, sides silvery; hinder part of back, adipose fin, and tail with numerous oblong spots; rays of dorsal fin 11; anal 15; scales very small, 170 in the lateral line; pyloric cæca 180: Pacific Ocean, from central California northwards; common in Alaska; of small food value.

*O. keta* (Walbaum). Dog salmon. Weight 12 lbs.; head 4; depth 4; color dusky above; sides paler; no spots, only fine dots, which may be absent; breeding male with brick-red sides, often barred or mottled; rays of dorsal fin 9; anal 13 or 14; scales 28-150-30; pyloric cæca 140 to 185: San Francisco to Bering Straits; of small food value.

*O. tschawytscha* (Walbaum). Chinook; king salmon; quinnat salmon. Length 600 to 1,500 mm.; usual weight 22 lbs.; extreme weight 100 lbs.; head 4; depth 4; color dusky above; sides silvery; back and tail spotted with small black spots; rays of dorsal fin 11; anal 16; scales 27-146-29; body robust; flesh red in the spring, becoming paler in the fall; pyloric cæca 145 to 185: Ventura river, California, to Alaska; the principal salmon in the Columbia and Sacramento Rivers; the most important food fish in the country; introduced into eastern America.

*O. kisutch* (Walbaum). Silver salmon. Length 375 mm.; weight 5 lbs.; color bluish green; sides silvery with dark punctulations; no spots except a few obscure ones; males mostly red in the fall; rays of the dorsal fin 10; anal 13 or 14; scales 25-127-29; pyloric cæca 45 to 80: San Francisco northwards; the principal salmon in Puget Sound and in the shorter rivers of Oregon and Washington; a very important food fish.

*O. nerka* (Walbaum). Blueback; redfish. Length 600 mm.; weight 6 lbs.; head 4; depth 4; color bright blue above and without spots; sides silvery; breeding male blood red above, white below; rays of dorsal fin 11; anal 14 to 16; scales 20-133-20; body rather slender; flesh deep red: California to Alaska; the principal salmon of the Fraser River and of Alaska; after the king salmon the most important member of the genus commercially.

**2. Salmo** L. Salmon; trout. Body elongate; mouth large; dorsal and anal fins usually with 10 to 12 rays each; body usually spotted with black: about 30 species in the United States, mostly in the west.

*S. salar* L. Atlantic salmon. Length to 1,500 mm.; average weight 15 lbs.; body slender, elliptical; head 4; depth 4; rays of dorsal fins 11; anal 9; scales 23-120-21; color brownish above; sides silvery, with numerous black spots all over; young with 11 dusky cross bars, and spots and red patches: north Atlantic Ocean, ascending the rivers north of Cape Cod, and occasionally as far south as the Delaware; sometimes landlocked in lakes; an important game fish; northern Europe, as far south as northern Spain. The salmon enters the rivers in the spring to feed, but probably returns to the sea before spawning, and again ascends late in the fall for that purpose.

### *Subspecies of S. salar*

*S. s. sebago* Girard. Smaller and non-migratory; average weight 2 lbs.: Sebago Pond, Maine, and other lakes to the northward.

*S. s. ouananiche* Jordan & Evermann. Average weight 2 lbs.; teeth, fins and eyes very large: Lake St. John and other lakes in Quebec.

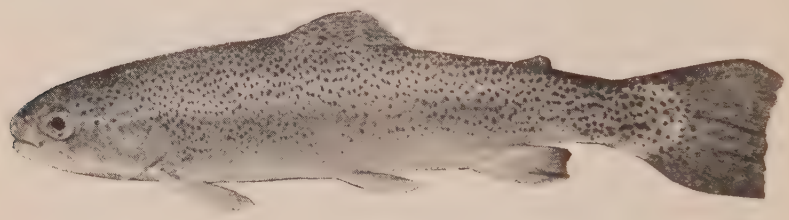


FIG. 20.—*Salmo clarki* (*from Jordan & Evermann*).

*S. clarki* Richardson. Cutthroat trout; black-spotted trout (Fig. 20). Length up to 400 mm. or more; weight up to 20 lbs.; head 4; depth 4; rays of dorsal fin 10; anal 10; scales 39-160 to 170-30; body elongate; head short and blunt; pyloric cæca 43; color usually silver gray, profusely spotted with black, round spots which may extend on to the belly; lower jaw blotched with red (cutthroat); middle of side usually with a broad rosy wash: coastal streams and lakes from northern California to British Columbia and Alaska; up the Columbia River basin as far as Shoshone Falls; spawning in the spring and early summer.

*S. lewisi* (Girard). Yellowstone trout. Similar to *S. clarki*, but more robust; spots not extending on the belly: Columbia River basin above Shoshone Falls; head waters of the Missouri; Yellowstone Park.

*S. gibbsi* (Suckley). Silver trout. Similar to *S. clarki*, but with scarcely any red on the lower jaw; scales 140 to 145: Idaho, Oregon and Washington between Shoshone Falls and the Cascades.

*S. henshawi* Gill & Gordon. Tahoe trout; redfish. Similar to *S. clarki;* body slender; head pointed; rays of dorsal fin 11; anal 12; color green above, sides silvery, with a copper shade; spotted all over: lakes and streams on the eastern slope of the Sierras.

*S. tahoensis* J. & E. Silver trout. Similar to *S. clarki;* size very large; rays of dorsal fin 9; anal 12; scales 33-205-40: Lake Tahoe, in deep water.

*S. virginalis* Gir. Similar to *S. clarki;* scales 145; spots small and confined to the back; size very large: Utah westward of the Wasatch Mountains.

*S. spilurus* Cope. Rio Grande trout. Similar to *S. clarki;* spots most numerous on the hinder half of body: upper Rio Grande basin; southward into Mexico.

FIG. 21.—*Salmo gairdneri (from Jordan & Evermann).*

*S. pleuriticus* Cope. Similar to *S. clarki;* scales 185 to 190; size large; lower fins red; spots numerous: head waters of the Colorado.

*S. bouvieri* Bendire. Similar to *S. clarki;* spots all behind the dorsal fin: Waha Lake, Idaho.

*S. stomias* Cope. Green-back. Similar to *S. clarki;* body deep green above; spots mostly back of the anal fin: head waters of the Arkansas and South Platte.

*S. macdonaldi* J. & E. Yellow-fin. Similar to *S. clarki;* spots small and numerous on hinder part of body, few or none anteriorly; lower fins bright yellow; size large: Twin Lakes, Colorado.

*S. declivifrons* Meek. Similar to *S. clarki;* color dark blue; fore part of the body with a sharp upward curve; scales 148; no spots except a few on the caudal fin: Lake Southerland, Washington.

*S. jordani* Meek. Similar to *S. clarki;* spots very numerous and very black; fins orange; scales 146: Lake Southerland, Washington.

*S. gairdneri* Richardson. Steelhead trout (Fig. 21). Length 750 mm.; weight about 4 lbs.; extreme weight 20 lbs.; color olive green above; sides silvery; back and sides more or less covered with small black

spots; sides often with a broad pink stripe; rays of dorsal fin 11; anal 12; scales about 150: Pacific Ocean and coastwise streams from Santa Barbara, California to British Columbia and northwards; an important food and game fish.

*S. kamloops* Jordan. Similar to *S. gairdneri;* form more slender; head 4.5; depth 4.3 scales 30-135 to 146-26; a broad lateral band of bright rose color; under parts silvery; lakes in the basin of the upper Columbia and Fraser Rivers.

*S. beardsleei* Jordan & Seale. Blue-back. Similar to *S. gairdneri;* color very dark blue; no lateral rosy band; under parts white, not silvery; size large; scales 130: Crescent Lake, Washington.

FIG. 22.—*Salmo irideus* (*from Jordan & Evermann*).

*S. crescentis* Jordan & Beardslee. Similar to *S. gairdneri;* color very dark blue; spots not numerous; a large black blotch on the cheek: Crescent Lake, Washington.

*S. bathœcetor* Meek. Length 600 mm.; head 3.5; depth 5.5; scales 150; rays of dorsal fin 10; anal 11; color blue; spots numerous; form slender: Crescent Lake, Washington.

*S. irideus* Gibbons. Rainbow trout (Fig. 22). Length 375 mm. or more; weight about 3 lbs.; head 4; depth 3.8; rays of dorsal fin 11; anal 10; scales 21-135-20; color bluish above; sides silvery, with a broad pink lateral band; back profusely spotted: in mountain brooks of the Coast Range of California.

*S. masoni* Suckley. Similar to *S. irideus;* mouth very small; scales 120 to 130: coastwise streams of Oregon and Washington.

*S. shasta* Jordan. Rainbow trout. Similar to *S. irideus;* coloration rather dark; spots extending at least to the lateral line; scales 145: streams of the Sierra Nevada from Mount Shasta southward; the usual rainbow trout of the fish culturists, which has been introduced extensively into the eastern States.

*S. gilberti* Jord. Similar to *S. irideus;* scales 165; back and sides profusely spotted: Kern River, California.

*S. stonei* Jord. Similar to *S. irideus;* size much larger; scales 155; spots few, mostly on the hinder part of the body: upper Sacramento basin.

*S. agua-bonita* Jord. Similar to *S. irideus;* size very small; scales 175; sides and belly golden; spots few: south Fork of the Kern River, California.

*S. roosevelti* Evermann. Golden trout. Length 30 mm.; head 3.5; depth 4; rays of dorsal fins 11; anal 11; scales 200; color olive above, golden yellow below the lateral line; a broad rosy lateral band crossed by 10 black blotches and a midventral red stripe present; lower fins

FIG. 23.—*Cristivomer namaycush (from Jordan & Evermann's Salmonoid Fishes of the Great Lakes).*

red; dorsal and caudal fins and tail alone spotted: Volcano Creek, Kern River basin, California.

*S. whitei* Evermann. Golden trout. Similar to *S. roosevelti;* back and sides profusely spotted; scales larger; lower fins yellowish; no red on throat: in the western tributaries of the Kern River, California.

*S. regalis* Snyder. Greenback. Length 325 mm.; head 4.4; depth 4; scales 144; color steel blue or green above, silvery on the sides, without spots or bars: Lake Tahoe region.

*S. smaragdus* Snyder. Greenback. Similar to *S. regalis;* form slender; scales 124; color green above: Pyramid Lake region, Nevada.

*S. aquilarum* Snyder. Length 480 mm.; head 4.2; depth 4.2; scales 136; color dark olive above; below the lateral line and on belly coppery red; a trace of red on the throat; profusely spotted above the lateral line: Eagle Lake, California.

**3. Cristivomer** Gill & Jordan. Great Lakes trout. Body of large size, spotted with gray; scales very small; vomer elongate, with a raised

median crest armed with strong teeth; hyoid with a broad band of strong teeth: 2 species, which are the largest of the trouts.

*C. namaycush* (Walbaum). Mackinaw trout; lake trout (Fig. 23). Length 900 mm.; head 4.5; depth 4; average weight 16 lbs.; extreme weight 90 lbs.; color dark gray, often greenish on the sides, everywhere with rounded paler spots which are often tinged with reddish; rays of dorsal fin 11; anal 11; scales 185 to 205; body elongate; head very long; mouth large: northern North America from Maine to Vancouver and northward to the Arctic and Alaska; common in the Great Lakes, where after the sturgeon, it is the largest fish, and, after the whitefish, the most important fish commercially.

*C. siscowet* (Agassiz). Similar to *C. namaycush*, but with a deeper body and an excessive development of fatty tissue beneath the skin; color paler; scales 175: Lake Superior; abundant in deeper water; also in Lakes Huron and Erie.

**4. Salvelinus** Nilsson. Brook trout. Body moderately elongate, spotted with red; scales very small and imbedded and hidden; vomer elongate, with teeth on front end only, hinder portion depressed and without teeth; hyoid with weak teeth or none: many species, which live in cold, clear streams in the northern hemisphere, sometimes descending into the sea; 4 species in the United States.

**Key to the Species of Salvelinus in the United States**

$a_1$ In the eastern and central States.
  $b_1$ Back marbled with dark olive and unspotted; sides spotted. . . *S. fontinalis.*
  $b_2$ Back not marbled or spotted; sides spotted.
    $c_1$ Rays of dorsal fin 13; anal 12 . . . . . *S. alpinus.*
    $c_2$ Rays of dorsal fin 10; anal 9 . . . . . *S. oquassa.*
    $c_3$ Rays of dorsal fin 9; anal 8 . . . . . *S. aureolus.*
$a_2$ On the Pacific slope . . . . . *S. parkei.*

*S. fontinalis* (Mitchill). Brook trout; speckled trout. Length 200 mm. or more; weight 1 lb. or more; extreme weight 8 lbs.; head and depth 4.5; color of back and sides dark olive, marbled or barred on the back and with numerous red spots on the sides, each spot margined with brown; lower fins dusky, edged anteriorly with black and orange; rays of dorsal fin 10; anal 9; scales 37-230-30: Maine to Montana and Saskatchewan; northward into Labrador; southward in the Appalachian Mountains to Georgia; in none of the Great Lakes except Lake Superior; introduced into other parts of the country; spawning occurs in the fall, the eggs hatching the following spring.

*Subspecies of S. fontinalis*

*S. f. agassizii* Garman. Color pale grayish; red spots very few: lakes of New Hampshire.

*S. parkei* (Suckley). Dolly Varden trout. Length 500 mm.; weight up to 12 lbs.; head 3.6; depth 4; color olivaceous, the sides with round red spots nearly the size of the eye, the back with smaller, paler ones; rays of dorsal fin 11; anal 9; scales 39-240-36; body rather slender: east and west slopes of the Cascade Range from the upper Sacramento to Montana, and northward into Alaska; common.

*S. alpinus* (L.). Saibling; European trout. Length 225 mm.; head 4.5; depth 5; color grayish or greenish above, red beneath; sides silvery, with round red dots; rays of dorsal fin 13; anal 12; scales 195 to 200; body elongate, compressed; back not marbled: northern and central Europe; introduced into Starling Lake, New York.

*S. aureolus* Bean. American saibling. Length 300 mm.; head and depth 4.2; color dark green above, without mottling; sides silver gray, with small yellow spots; belly orange; fins very large; rays of dorsal fin 9; anal 8; scales 35-210-40: Sunapee Lake, Maine and other lakes in Maine and New Hampshire; probably introduced from Europe.

*S. oquassa* (Girard). Blueblack trout. Length 300 mm.; head and depth 5; color dark blue above with round red spots on the sides; rays of dorsal fin 10; anal 9; scales 230; body slender: Rangeley Lakes, Maine, and northwards.

**Family 5. Thymallidæ.**—Graylings. Body elongate, compressed, slender; head short; mouth terminal; maxillary extending to a point below the middle of the eye; tail forked; adipose fin present; dorsal fin very long and high, with simple anterior and bifurcated posterior rays: 1 genus.

**Thymallus** Cuvier. With the characters of the family: 5 species, all in the cold waters of the northern hemisphere, 2 in the United States.

*T. tricolor* Cope (Fig. 24). Michigan grayling. Length 450; head 5; depth 4.6; color purplish gray; sides with small scattered black spots back of head; dorsal fin spotted and with rose colored and dark stripes; rays of dorsal fin 21 or 22; anal 11; scales 93 to 98: northern Michigan; scarce.

*T. montanus* Milner. Montana grayling. Similar to *T. tricolor*, but with dorsal fins a little smaller and with smaller scales; sides with transversely elongated spots: upper Missouri basin, above the Great Falls; locally abundant.

**Family 6. Argentinidæ.**—Smelt. Body elongate, slender, small, covered with usually cycloid scales; head naked; mouth terminal; stomach a blind sac, the cardiac and pyloric ends being close together; pyloric cæca few or wanting; adipose fin present; tail forked: about 12 genera and 15 species, mostly marine, some of the species ascending the streams; 2 genera in the United States.

1. **Thaleichthys** Girard. Body very slender; scales very small; teeth very feeble: 1 species.

*T. pacificus* (Richardson). Candlefish. Length 300 mm.; head 4.75; depth 6; color white, with numerous dark dots above; rays of dorsal fin 11; anal 21; scales 75; lower jaw projecting: Oregon to

Fig. 24.—*Thymallus tricolor* (*from Jordan & Evermann*).

Alaska; marine; ascending the streams from the Fraser River northwards in enormous numbers in the spring; flesh very oily and of delicious flavor; an important food fish; when dried used as candles.

2. **Osmerus** L. Body very slender; teeth strong, those on the tongue long and fang-like; scales large; 5 species in the United States along the shores of both oceans, 1 ascending the streams.

*O. mordax* (Mitchill). American smelt. Length 300 mm.; head 4; depth 6.5; color greenish above, with dark dots; sides silvery; rays of dorsal fin 10; anal 15; scales 68; mouth large, lower jaw projecting: Atlantic Ocean from Virginia to Labrador, ascending the streams in the winter to spawn in immense numbers; common in Lake Champlain and other lakes; often landlocked; an important food fish.

*O. thaleichthys* Ayres. Length 200 mm.; head 4.5; depth 5.5; color olivaceous; rays of dorsal fin 9; anal 14; scales 55 to 58: Pacific Ocean from San Francisco to Alaska, ascending the streams in February.

**Order 2. Apodes.**—Body very elongate, cylindrical, with minute imbedded scales or none; ventral fins wanting; anterior vertebræ distinct, without Weberian ossicles; premaxillaries atrophied or absent;

maxillaries lateral; air bladder, if present, with pneumatic duct; opercular and pharyngeal bones more or less deficient; fins without spines; gill-openings small; pseudobranchiæ absent: 10 families, the species being mostly marine and tropical; 1 species in the United States.

**Family Anguillidæ.**—Eels. Body very elongate, compressed behind; head conical; mouth large, with projecting jaw; operculum present; dorsal and anal fins confluent with the caudal; scales minute, imbedded and hidden; lateral line present: 1 genus, with 4 or 5 species, which occur in fresh, salt and brackish water in all parts of the world except the Pacific coasts of North America and the islands of the Pacific. American eels breed in the ocean between the West Indies and Bermuda, and die soon after. Spawning may also occur in fresh water. The young eels are very different in appearance from their parents and are called *Leptocephali*. During the second spring the young eels ascend the streams to feed in fresh water, in which they live several years. When they are full grown they descend the streams to the sea; their reproductive glands, however, do not mature for several weeks. Eels eat fishes, crustaceans and carrion, and are voracious feeders. They are important food fishes.

**Anguilla** Shaw. With the characters of the family: several species, 1 in America.

*A. chrisypa* Rafinesque (*A. rostrata* LeSueur). Common eel. Length 1,500 mm. or less; weight up to 7 lbs.; color brown, often yellowish, paler beneath; head 7; depth 12 to 17: Atlantic Ocean, from Newfoundland to Mexico; also in the West Indies; ascending all the rivers east of the Rockies; not found in the Great Lakes above Niagara Falls or the upper Mississippi Valley, unless introduced.

**Order 3. Eventognathi.**—The suckers and carps. Anterior vertebræ modified, with Weberian ossicles; fins soft-rayed, being without spines; ventral fins abdominal; no adipose fin; lower pharyngeals falciform, parallel with the gill-arches; maxillaries perfect; jaws toothless; no pyloric cæca; air bladder with pneumatic duct: 2 very large families of fresh water fishes.

**Key to Families of Eventognathi**

$a_1$ Lips usually thick and fleshy; dorsal rays with more than 10 rays. 1. *Catostomidæ.*
$a_2$ Lips thin; dorsal fin with less than 10 rays..... 2. *Cyprinidæ.*

**Family 1. Catostomidæ.**—Suckers; mullets. Fishes of medium size, with an elongate, more or less compressed body covered with

cycloid scales; head naked, without barbels; jaws toothless; mouth usually with thick, fleshy, protractile lips; sides of the upper jaw formed by the maxillaries; lower pharyngeal bones with a single row of teeth; branchiostegals 3; gill membranes united to the isthmus; pseudobranchiæ present; fins not scaled; dorsal fin often long; anal fin short; tail forked; air bladder large, divided into 2 or 3 compartments: about 15 genera and 70 species, of which 2 occur in eastern Asia and the others in the fresh waters of North America. They live near the bottom and feed on vegetation and small, inactive animals. In the spring they usually ascend the streams to spawn, often in swarms. The flesh of most species is not highly valued for food.

**Key to the Genera of Catostomidæ**

$a_1$ Dorsal fin long, with 24 to 30 rays; air bladder in 2 parts.
  $b_1$ Scales large, 35 to 41 being in the lateral line.
    $c_1$ Mouth large, terminal, protractile forward ..... 1. *Ictiobus.*
    $c_2$ Mouth small, inferior, protractile downward ..... 2. *Carpiodes.*
  $b_2$ Scales smaller, about 56 in the lateral line ..... 3. *Cycleptus.*
$a_2$ Dorsal fin with 9 to 18 rays.
  $b_1$ Scales small, 50 or more in the lateral line; air bladder in 2 parts.
    $c_1$ Small species in the Rocky Mountain region; hinder division of air bladder slender ..... 4. *Pantosteus.*
    $c_2$ Hinder division of air bladder broad.
      $d_1$ No hump back of head.
        $e_1$ Mouth inferior, with thick papillose lips ..... 5. *Catostomus.*
        $e_2$ Mouth large, terminal, with thin lips ..... 6. *Chasmistes.*
      $d_2$ A high hump back of the head ..... 7. *Xyrauchen.*
  $b_2$ Scales larger, 36 to 50 in the lateral line.
    $c_1$ Lateral line wanting or incomplete; air bladder in 2 parts.
      $d_1$ Lateral line entirely wanting ..... 8. *Erimyzon.*
      $d_2$ Lateral line interrupted ..... 9. *Minytrema.*
    $c_2$ Lateral line complete; air bladder in 3 parts.
      $d_1$ Lower lip entire or merely lobed.
        $e_1$ Teeth compressed; mouth small ..... 10. *Moxostoma.*
        $e_2$ Lower teeth enlarged and cylindrical; mouth large ..... 11. *Placopharynx.*
      $d_2$ Lower lip split, forming two separate lobes ..... 12. *Logochila.*

**1. Ictiobus** Rafinesque. Buffalo fish. Large, rather stout fishes with large head, furrowed opercles and broad subopercles; fontanelle present; mouth large for the family; lips thin; scales large; lateral line prominent; dorsal fin long, the anterior rays being longer than

the others: 3 species in the United States, 1 in Mexico, all rather important food fish.

**Key to the Species of Ictiobus in the United States**

$a_1$ Lips smooth.....*I. cyprinella.*
$a_2$ Lips plicate or papillose.
  $b_1$ Back scarcely elevated.....*I. urus.*
  $b_2$ Back elevated and compressed.....*I. bubalus.*

*I. cyprinella* (Cuvier and Valenciennes) (Fig. 25). Common buffalo. Length 900 mm.; extreme weight 50 lbs.; head 3.5; depth

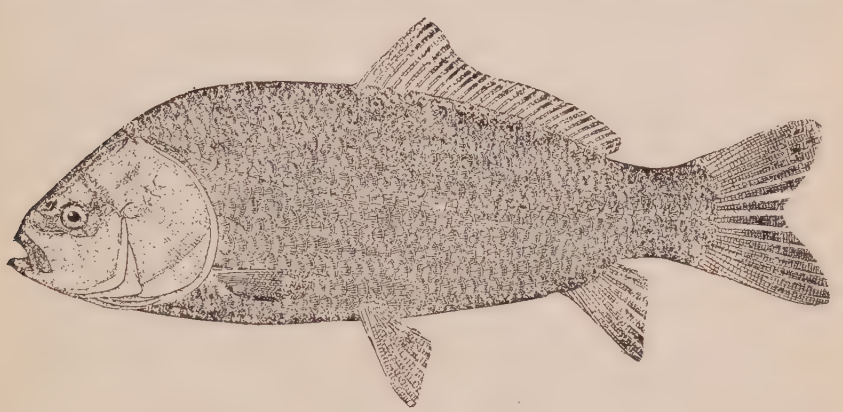


FIG. 25.—*Ictiobus cyprinella (from Jordan & Evermann).*

3; color brownish olive; rays of dorsal fin 27 to 29; anal 9; scales 7-37 to 41-6: Mississippi Valley; common in large streams.

*I. urus* (Agassiz). Black buffalo. Similar to *I. cyprinella*, but with a smaller mouth and a much darker color; head 4; dorsal fin with 30 rays; anal 10; scales 8-41-7: Mississippi Valley; less common than *I. cyprinella.*

*I. bubalus* (Raf.). Small-mouthed buffalo. Extreme length 900 mm.; extreme weight 35 lbs.; head 4; depth 2.5; mouth small, inferior; color pale; dorsal fin with 29 rays; anal 10; scales 8-39-6: Mississippi Valley; common; in the larger rivers.

**2. Carpiodes** Rafinesque. Carp suckers. Similar to *Ictiobus*, but smaller, pale and silvery in color and with a weak dentition: 5 species; all of little food value.

**Key to the Species of Carpiodes**

$a_1$ In the Mississippi and Great Lakes basins.
  $b_1$ Body subfusiform and robust; depth about 3.....*C. carpio.*
  $b_2$ Body thin and compressed; depth about 2.5; opercle striate.

$c_1$ Lips thin and white.
$d_1$ Snout very blunt, the nostrils being near the tip.....*C. difformis.*
$d_2$ Head small and pointed.....*C. thompsoni.*
$c_2$ Lips thick and reddish in color.....*C. velifer.*
$a_2$ On the Atlantic slope.....*C. cyprinus.*

*C. carpio* (Raf.). Carp sucker. Extreme length 900 mm.; extreme weight 10 lbs.; head 4 to 5; depth 3; color silvery gray; rays of dorsal fin 30; anal 7; scales 36; lips thin: Ohio Valley, southwestward to central Texas; abundant.

*C. difformis* Cope. Length 300 mm.; head 4.5; depth 2.5; color silvery; snout very blunt; rays of dorsal fin 24, the anterior rays greatly

FIG. 26.—*Carpiodes cyprinus (from Jordan & Evermann).*

elongated; anal 8; scales 6-35-6; dorsal fin very high: Ohio Valley and westwards; common.

*C. thompsoni* Agassiz. Length 500 mm.; head 4.25; depth 2.5; color silvery; rays of dorsal fin 27; anal 7; scales 7-39 to 41-6; head small and pointed: basins of the Great Lakes and the St. Lawrence; common.

*C. velifer* (Raf.). Quillback. Length 300 mm.; head 4; depth 2.5 to 3; color pale; rays of dorsal fin 26 or 27, the anterior rays twice as long as the others; scales 7-37 to 40-6; opercle striate; lips thick and flesh-colored in life, the two halves of lower lip meeting at an acute angle· Mississippi Valley and southwestward to the Rio Grande; common.

*C. cyprinus* (LeSueur). Carp sucker (Fig. 26). Similar to *C. velifer*, but with a smooth opercle; body elongate: streams entering Chesapeake Bay; common.

**3. Cycleptus** Rafinesque. Body elongate and similar to the two previous genera, but with a closed fontanelle; head very small: 1 species.

*C. elongatus* (LeSueur). Blackhorse; Missouri sucker. Length 750 mm.; head 6 to 8; depth 4 to 5; color blackish; dorsal fin with 30 rays, the anterior 2 or 3 being much prolonged; anal fin with 7 to 8 rays; scales 9-56-8; mouth small; upper lip thick and pendant: Mississippi Valley, often common in large streams; a good food fish.

**4. Pantosteus** Cope. Mountain suckers. Body small, elongate, similar to *Catostomus;* mouth ventral, with a cartilaginous sheath on each jaw: several species, in the Rocky Mountain region, all of little food value.

*P. generosus* (Girard). Length 200 mm.; head 5; depth 5.5; color light brown, with dusky spots; chin, fins and lateral band red in male; rays of dorsal fin 9; scales 15-81-14: Great Basin of Utah; very common.

*P. plebeius* (Baird & Girard). Length 300 mm.; head 4.6; depth 4.75; color dark brown with orange lateral markings in male; scales 80; body stout: basin of the Rio Grande; very common.

*P. delphinus* (Cope). Length 300 mm.; head 4.75; color bluish above, yellowish below; sides of male rosy; rays of dorsal fin 10; scales 16-96 to 105-14; tail very slender: basin of the Colorado; very common.

*P. jordani* Evermann. Length 300 mm.; head and depth 5; color dark greenish, speckled; males with orange lateral band; dorsal fin with 10 or 11 rays; anal with 7 rays; scales 16-90 to 100-14, 48 before the dorsal: basin of the upper Missouri and Columbia; generally distributed.

**5. Catostomus** LeSueur. Fine-scaled suckers. Body elongate; mouth rather large, ventral; upper lip thick, papillose and protractile; lower lip very large with a broad free margin usually in two more or less distinct lobes; scales small; dorsal and anal fins high and rather short: many species, all North American except *C. rostratus* Tilesius, which occurs in Siberia.

**Key to the Species of Catostomus here described**

$a_1$ More than 80 scales in the lateral line.
  $b_1$ Upper lip broad, with 5 or 6 rows of papillæ.
    $c_1$ Upper lip not projecting; in the Colorado River basin.
      $d_1$ In the lower Colorado basin..... *C. latipinnis.*
      $d_2$ In the upper Colorado basin..... *C. discobolus.*
    $c_2$ Upper lip very long and pendant; in the upper Missouri.. *C. griseus.*
    $c_3$ In northern California..... *C. rimiculus.*
  $b_2$ Upper lip narrow, with about 3 rows of papillæ.

$c_1$ In the northern United States.....*C. catostomus.*
$c_2$ In Lake Tahoe.....*C. tahoensis.*
$a_2$ Less than 75 scales in the lateral line.
$b_1$ In the western States.
$c_1$ On the Pacific slope.
$d_1$ In California.....*C. occidentalis.*
$d_2$ In Oregon.....*C. tsiltcoosensis.*
$d_3$ In Oregon and California.....*C. snyderi.*
$c_2$ In the Great Basin and the Rocky Mountains. ..*C. microps.*
$d_1$ From Oregon to Montana.....*C. macrocheilus.*
$d_2$ In Utah.....*C. ardens.*
$b_2$ In the eastern and central States.
$c_1$ Lateral line with 64 to 70 scales.....*C. commersoni.*
$c_2$ Lateral line with 46 to 51 scales.....*C. nigricans.*

*C. latipinnis* Baird & Girard. Length 600 mm.; head 4; depth 5.5; color dark olive; sides and fins orange; rays of dorsal fin 14 or 15; anal 7; scales 19-89 to 102-18, 46 to 50 before the dorsal fin; lips very thick, the lower extending backward to beneath the eye; fins very large: basins of the lower Colorado; common.

*C. discobolus* Cope. Length 300 mm. or more; head 3.8 to 4.5; depth 5.25; rays of dorsal fin 12 or 13; anal 7; scales 19 to 21-101 to 109-17 to 21, 52 to 63 before the dorsal fin; mouth as in *C. latipinnis;* muzzle extending to slightly beyond upper lip: upper Colorado basin; Montana.

*C. griseus* (Girard). Length 500 mm.; head 4; depth 5.5; color brown; rays of dorsal fin 10 to 12; scales 16-90 to 110-14; upper lip very long and pendant; lower lip deeply incised: upper Missouri basin; abundant in the Yellowstone.

*C. rimiculus* Gilbert & Snyder. Length 400 mm.; head 4; depth 5; color dusky; rays of dorsal fin 11; anal 7; scales 18-91-13, 42 before the dorsal fin; upper lip with 5 rows or tubercles: northern California.

*C. catostomus* (Forster). Long-nose sucker. Length 750 mm.; head 4.5; depth 4.5; rays of dorsal fin 10 to 11; anal 7; scales 14 to 17-95 to 117-13; upper lip with 2 to 4 rows of tubercles; lower lip deeply incised; mouth inferior; head very long and slender, the snout overhanging the mouth: from Maine and the basin of the St. Lawrence and the Great Lakes to southeastern Oregon and the upper Columbia, and northward to Alaska; abundant northward; spawning in spring; of some food value.

*C. tahoensis* Jordan. Red sucker. Similar to *C. catostomus,* but with 83 to 92 scales in the lateral line and a stouter body: region of Lake Tahoe; very abundant.

*C. occidentalis* Ayres. Length 250 mm.; head 4.5; depth 5; body slender; color dark above; dorsal fin with 12 to 14 rays; scales 13-75-10, 40 before the dorsal fin; middle California; common.

*C. mniotiltus* Snyder. Length 200 mm.; head and depth 4.8; rays of dorsal fin 12; anal 7; scales 57: Monterey County, California.

*C. macrocheilus* Girard. Length 150 mm.; head 4; depth 5; color dark, with a darker lateral stripe; rays of dorsal fin 12 to 14; anal 7; scales 12-72-10; head large; upper lip with 6 to 8 rows of papillæ: Oregon and Washington, into Montana; common.

*C. commersoni* (Lacépède). Common sucker (Fig. 27). Length 450 mm.; head and depth 4 to 5; color olivaceous; rays of dorsal fin

FIG. 27.—*Catastomus commersoni* (*from Jordan & Evermann*).

12; anal 7; scales 10-64 to 70-9; mouth large; upper lip narrow, with 3 to 5 rows of papillæ: Maine, Valley of the St. Lawrence and Great Lakes to Montana; northward to New Brunswick, Labrador and Hudson Bay; southward into Georgia and Missouri; very common in small streams and ponds; a good food fish.

*C. ardens* Jordan & Gilbert. Similar to *C. commersoni*, but with a larger mouth and lips; scales 12-70 to 72-12: Great Basin of Utah; very common.

*C. nigricans* LeSueur. Hog sucker. Length 600 mm.; head 4.5; depth 5; color olivaceous, sides brassy; lower fins red; back and sides with black blotches; rays of dorsal fin 10 or 11; scales 7-46 to 51-6; head large; upper lip very thick, with 8 to 10 series of papillæ: New York to Minnesota; southward to the Carolinas and Arkansas; abundant in clear streams.

*C. snyderi* Gilbert. Length 500 mm.; head 4.5; depth 4; color dusky; belly white; rays of dorsal fin 11; anal 7; scales 13-70-11: Klamath Lakes region.

*C. microps* Rutter. Length 130 mm.; head 4.5; depth 4.7; rays of dorsal fin 11; anal 7; scales 17-81 to 87-14; eye very small: Medoc County, California.

*C. tsiltcoosensis* Evermann & Meek. Length 300 mm.; head 4.5; depth 5; rays of dorsal fin 13; anal 7; scales 13-65-8, 34 before the dorsal: fins small: coastal streams of middle Oregon.

6. **Chasmistes** Jordan. Head large; snout elevated; mouth terminal and very large, with a long, very oblique lower jaw; upper lip thin and smooth; lower lip with a broad flap on each side and narrow in front: 6 species, all in the far-west.

### Key to the Species of Chamistes

$a_1$ Scales 60 to 65 in the lateral line.
  $b_1$ In Utah Lake..... *C. liorus.*
  $b_2$ In Pyramid Lake..... *C. cujus.*
$a_2$ Scales 70 to 80 in the lateral line; in the Klamath Lakes.
  $b_1$ Snout very short; rays of anal fin 9..... *C. brevirostris.*
  $b_2$ Rays of anal fin 7.
    $c_1$ Snout with prominent hump..... *C. stomias.*
    $c_2$ No hump on snout.
      $d_1$ Fins not very small..... *C. luxatus.*
      $d_2$ Fins very small..... *C. copei.*

*C. liorus* Jord. Length 450 mm.; head 3.5; depth 5; end of snout elevated; color dusky; back and sides covered with dark punctulations: rays of dorsal fin 11; anal 7; scales 9-63-8: Utah Lake; very common;

*C. cujus* Cope. Rays of dorsal fin 11; anal 7; scales 13-65-11. Pyramid Lake, Nevada, in deep water.

*C. brevirostris* Cope. Rays of dorsal fin 11; anal 9; scales 12-75-11: Klamath Lakes, Oregon.

*C.* (*Deltistes* Seale) *luxatus* Cope. Length 900 mm.; head 4; depth 4.8; color dusky, with black punctulations; rays of dorsal fin 12; anal 7; scales 12-76 to 81-9; body elongate; head very long and slender: Klamath Lakes region, where it is abundant and the most important food fish.

*C. stomias* Gilbert. Length 450 mm.; color dark above; rays of dorsal fin 10; anal 7; scales 14 or 15-76 to 82-11: Upper Klamath Lake; common.

*C. copei* Evermann & Meek. Similar to *C. stomias;* scales 13-80-12; mouth very oblique: Klamath Lakes.

**7. Xyrauchen** Eigenmann & Kirsch. Like *Catostomus*, except that immediately behind the head is a very prominent, sharp-edged hump; snout blunt: 1 species.

*X. cypho* (Lockington). Razor-back. Head and depth 4; rays of dorsal fin 13 or 14; anal 7; scales 13 to 15-72 to 77-13; color olivaceous: Colorado basin; abundant.

**8. Erimyzon** Jordan. Body fusiform, compressed; scales large; lateral line wanting: 1 species.

*E. sucetta* (Lacépède). Chub sucker (Fig. 28). Length 250 mm.; head 4.25; depth 3; color dusky, with a coppery lustre; young with a

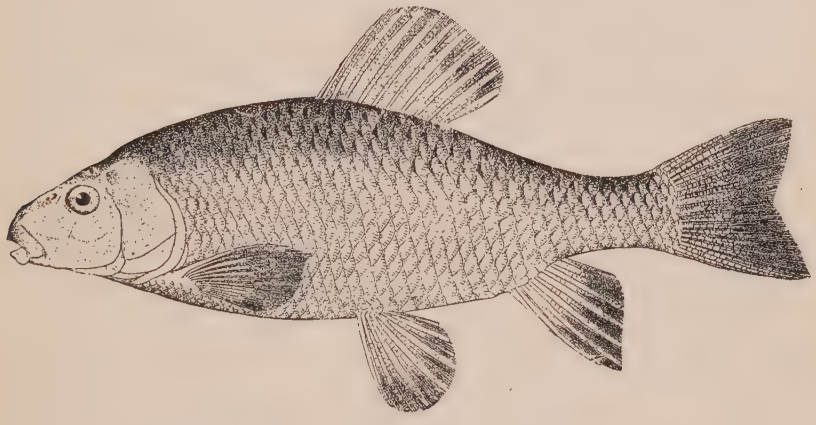


FIG. 28.—*Erimyzon sucetta* (*from Jordan & Evermann*).

broad black lateral band or series of blotches; rays of dorsal fin 11 to 12; anal 7; scales 36-15, in southern specimens, but 43-15 north of Virginia: Great Lakes region; Mississippi Valley; coastwise from Virginia to Texas; very common.

**9. Minytrema** Jordan. Body elongate, little compressed, with an interrupted lateral line in the adult, and a small black spot at the base of each scale on the side: 1 species.

*M. melanops* (Rafinesque). Spotted sucker. Length 600 mm.; head 4.3; depth 3 to 4; color dusky above, with usually a black blotch behind the dorsal fin; rays of dorsal fin 12 to 14; anal 7; scales 44 to 47: Great Lakes to North Carolina; upper Mississippi Valley to Texas; common.

**10. Moxostoma** Rafinesque. Redhorse. Body elongate; mouth inferior; lips well developed, with transverse folds (Fig. 29); jaws without cartilaginous sheath; upper lip protractile; scales large; anal fin high, with 7 rays; fontanelle present: about 20 species, mostly of small size, all in the eastern and central States.

### Key to the Species of Moxostoma

$a_1$ On the Atlantic slope.
  $b_1$ Lips papillose..... *M. papillosum.*
  $b_2$ Lips not distinctly papillose.
    $c_1$ Dorsal fin with usually 13 rays..... *M. crassilabre.*
    $c_2$ Dorsal fin with 10 to 12 rays.
      $d_1$ Scales of lateral line 50..... *M. rupiscartes.*
      $d_1$ Scales in lateral line 43..... *M. cervinum.*
$a_2$ In the central States.
  $b_1$ In the Great Lakes and upper Mississippi regions.
    $c_1$ Rays of dorsal fin 15 to 18..... *M. anisurum.*
    $c_2$ Rays of dorsal fin 10 to 14.
      $d_1$ Lobes of caudal fin equal..... *M. aureolum.*
      $d_2$ Upper lobe of caudal fin the longer..... *M. breviceps.*
  $b_2$ In the region of the southern Mississippi..... *M. pœcilurum.*

*M. papillosum* (Cope). White mullet. Length 600 mm.; head and depth 4; color silvery; lower fins usually reddish; lips full, the folds broken into papillæ; rays of dorsal fin 12 to 14; scales 6-42-5: Atlantic slope, from Dismal Swamp to central Georgia; common.

Fig. 29—Lips of *Moxostoma aureolum* (*from Fishes of Illinois*).

*M. anisurum* (Raf.). Whitenose. Length 450 mm.; head 4; depth 3 to 4; color silvery; fins large; lower fins reddish; rays of dorsal fin 15; scales 6-42 to 45-6; lips plicate; mouth large: Great Lakes region and Ohio River basin; not common.

*M. aureolum* (LeSueur). Common redhorse (Fig. 29). Length 600 mm.; head 4 or 5; depth 3.5; color olivaceous; sides silvery; lower fins red in adult; rays of dorsal fin 12 to 14; scales 5-41 to 45-5 to 7; head small; lips thick: Lake Ontario to upper Mississippi Valley; southwestward to Missouri and Arkansas; southeastward to North Carolina and Georgia; common; the most important food fish of the genus.

*M. crassilabre* (Cope). Length 600 mm.; head 5; depth 3.5; color pale yellowish or reddish; rays of dorsal fin 12 or 13; scales 5-44-5; lips full: eastern North Carolina; abundant.

*M. breviceps* (Cope). Length 300 mm.; head 5; depth 3.5; color silvery; lower fins bright red; rays of dorsal fin 12 or 13; scales 6-45-5; upper lobe of caudal fin much longer than the lower: Great Lakes and Ohio Valley; abundant in Lake Erie.

*M. rupiscartes* Jordan & Jenkins. Length 300 mm.; head 5; depth 5.5 to 6; color olive brown; rays of dorsal fin 11; anal 8; scales

6-50-6, 18 before the dorsal fin: south Atlantic States, from the Catawba to the Chattahoochee Rivers; often abundant.

*M. cervinum* (Cope). Length 250 mm.; head 5; body elongate; color greenish brown, with a pale blotch on each scale, these forming continuous lines along the sides; rays of the dorsal fin 10 to 12; scales 6-43-5, 13 before the dorsal: from the James River to the Neuse; abundant in rapid water.

*M. pœcilurum* (Jordan). Size small; head and depth 4.3; caudal fin red, lower lobe jet black with a white margin; rays of dorsal fin 13; scales 5-44-4: southern Mississippi and eastern Texas.

**11. Placopharynx** Cope. Large suckers, like *Moxostoma*, except that the pharyngeal bones are stronger and the lower teeth very large, nearly cylindrical in form, and 6 to 10 in number; upper teeth small and compressed: 1 species.

*P. duquesnei* (LeSueur). Big-jawed sucker. Length 750 mm.; head 4; depth 3.8; color dark olive green; caudal and lower fins bright red; rays of dorsal fin 12 or 13; anal 9; scales 6-45-6; head and mouth large; lips very thick: Michigan to Georgia and Arkansas; abundant in large streams.

**12. Logochila** Jordan & Brayton. Like *Moxostoma*, except that the upper lip is not protractile and the lower lip is split, consisting of two lobes: 1 species.

*L. lacera* J. & B. Harelip sucker. Head short; depth 4.6; color pale olive; sides and belly silvery; rays of dorsal fin 12; anal 7; scales 5-45-5; mouth large, inferior, the upper lip being prolonged: middle Mississippi Valley; locally common.

**Family 2. Cyprinidæ.**—Minnows; carp. Small or medium sized fishes with an elongate body, usually covered with cycloid scales and with a naked head; margin of the upper jaw formed by the premaxillaries alone; jaws toothless; the two paired lower pharyngeal bones parallel with the gill arches, each being falciform in shape and bearing 1 or 2 (in some European species 3) rows of teeth on each side, there being 4, 5 or 6 teeth in the main or hindermost row in the American species, and 1 or 2 teeth in the other row, if present at all; pseudobranchiæ usually present; branchiostegal rays 3; gills 4; fins typically spineless; ventral fins abdominal in position; air bladder large, with usually 2 compartments: over 200 genera and 1,000 species, in North America and the Old World, all in fresh water; over 200 species in the United States, most of which have no food value.

The American species are mostly small, often very small, fishes which abound in every brook and small stream. Many are very

brightly colored, especially in the springtime when the males have their nuptial coloration of reds and yellows. Numerous conspicuous tubercles may also cover the top of the head and other portions of the body of the male at this time. Two important members of this family have been introduced from Europe, the carp and the goldfish, both however natives of China, where they have been domesticated from time immemorial.

In the classification of these small fishes the lower pharyngeal teeth (Fig. 30) are of great importance, and their number and form are usually given in the descriptions. Thus "teeth 4-4" means that there is a single row of 4 pharyngeal teeth on each side of the mouth; "teeth

*a* *b*

FIG. 30.—Lower pharyngeal teeth of the chub (*Semotilus atromaculatus*): *a*, head of fish with left opercle removed showing the left pharyngeal arch back of the gill-arches; *b*, the two pharyngeal arches, the formula of the teeth being, 2, 4-5, 2 (*from Fishes of Illinois*).

4-5" means there is a row of 4 teeth on one side and 5 on the other; "teeth 1, 4-5, 2" means there are 4 teeth in the main or hindermost row and 1 tooth in the second of foremost row on one side, and on the other side 5 and 2 teeth, respectively, in the two rows. In the herbiverous species the teeth are nearly straight, and either without a hook at the tip or with a slight hook. Near the base of the tooth is often a masticatory surface in the form of a groove.

**Key to the Genera of United States Cyprinidæ (not including the European Carp and the Goldfish)**

$a_1$ Digestive canal very long, being more than twice the length of the body; peritoneum usually black; herbivorous fishes.
  $b_1$ Digestive canal wound around air bladder..... 3. *Campostoma.*
  $b_2$ Digestive canal not wound around air bladder.
    $c_1$ Pseudobranchiæ absent; on the Pacific slope..... 4. *Orthodon.*
    $c_2$ Pseudobranchiæ present.
      $d_1$ Each jaw with a conspicuous horny plate; in the Columbia basin..... 5. *Acrocheilus.*

$d_2$ Jaw without horny plate.
$e_1$ Teeth usually 5-5.
$f_1$ Lateral line complete; in California..... 6. *Lavinia.*
$f_2$ Lateral line incomplete; in the eastern and central States..... 7. *Chrosomus.*
$e_2$ Teeth 4-4.
$f_1$ First ray of dorsal fin not peculiar..... 8. *Hybognathus.*
$f_2$ First ray of dorsal fin separate and joined with the other rays by a membrane..... 9. *Pimephales.*
$a_2$ Digestive canal short, less than twice the length of the body; peritoneum usually pale; carnivorous fishes.
$b_1$ Teeth mostly blunt and enlarged, but slightly hooked; large fishes on the Pacific slope.
$c_1$ No barbels present..... 10. *Mylopharodon.*
$c_2$ Barbels present..... 11. *Mylocheilus.*
$b_2$ Teeth slender, hooked; species mostly not on Pacific slope.
$c_1$ Teeth in the main row 5-5 or 4-5.
$d_1$ Barbels present, often very small.
$e_1$ Tail symmetrical..... 12. *Semotilus.*
$e_2$ The upper lobe of tail longer than the lower; in California..... 13. *Pogonichthys.*
$d_2$ Barbels absent.
$e_1$ Abdomen behind ventral fins rounded and scaly.
$f_1$ Teeth two-rowed, usually 2 teeth being in the lesser row.
$g_1$ Size very large, the length being over 1,000 mm..... 14. *Ptychocheilus.*
$g_2$ Length not over 400 mm.
$h_1$ Caudal peduncle very long and slender..... 15. *Gila.*
$h_2$ Caudal peduncle stout..... 16. *Leuciscus.*
$f_2$ Teeth one-rowed, being either 4-5 or 5-5.
$g_1$ In the extreme western States.
$h_1$ Rays of dorsal fin 8..... 17. *Rutilus.*
18. *Hesperoleucus.*
$h_2$ Rays of dorsal fin 10..... 19. *Luxilinus.*
$g_2$ In the central and southeastern States. 20. *Opsopœodus.*
$e_2$ Abdomen behind the ventral fins acute and scaleless..... 21. *Abramis.*
$c_2$ Teeth in the main row 4-4, the lesser row being often absent.
$d_1$ Lower jaw normally formed.
$e_1$ Barbels absent.
$f_1$ Mouth not like that of a sucker.
$g_1$ First (rudimentary) ray of dorsal fin separated from next ray, to which it is joined by a membrane..... 22. *Cliola.*
$g_2$ First ray of dorsal fin closely joined to the next.

$h_1$ No conspicuous mucous channels in mandible and opercle; abdomen not carinated.....23. *Notropis.*
$h_2$ Conspicuous cavernous channels in mandible and opercle.....24. *Ericymba.*
$f_2$ Mouth and lower lips fleshy like a sucker's..25. *Phenacobius.*
$e_2$ Barbels present.
$f_1$ Scales small, 60 to 90 being in the lateral line.
$g_1$ Premaxillaries not protractile.....26. *Rhinichthys.*
$g_2$ Premaxillaries protractile.
$h_1$ Barbels minute.....27. *Agosia.*
$h_2$ Barbels well developed.....29. *Couesius.*
$f_2$ Scales large, there being 35 to 50 in the lateral line.
$g_1$ Head convex above; teeth 4-4 or 1, 4-4, 0 or 1.....28. *Hybopsis.*
$g_2$ Head flattened; teeth 2, 4-4, 2.....30. *Platygobio.*
$d_2$ Lower jaw three-lobed.....31. *Exoglossum.*

1. **Cyprinus** L. Body robust, compressed; mouth with 4 long barbels; snout rounded; pharyngeal teeth 1, 1, 3-3, 1, 1; scales large; dorsal fin very long; anal short: 1 species.

*C. carpio.* L. European carp (Fig. 31). Length 450 mm. or more; head 3 to 4; depth 2.75 to 3.4; color blackish gray above, yellowish on

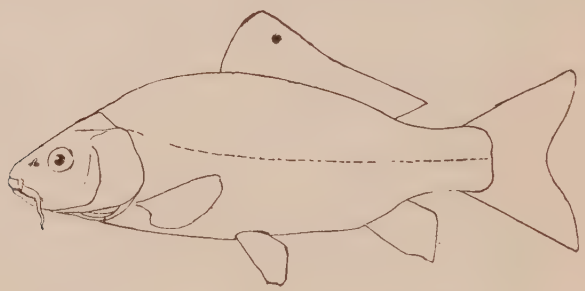


FIG. 31.—*Cyprinus carpio (from Süssw. Fauna Deut.).*

the sides and belly; 3 spinous and 17 to 21 soft rays in dorsal fin and 3 spinous and 5 soft rays in the anal fin; scales 5 or 6-35 to 37-5 or 6: fresh waters of eastern Asia and introduced into Europe and America; abundant and an important food fish in the eastern and central parts of the country.

2. **Carassius** Nilsson. Body oblong; mouth without barbels; scales large; pharyngeal teeth 4-4; dorsal fin very long: 1 species.

*C. auratus* (L.) Goldfish. Length up to 400 mm.; color olivaceous, becoming reddish or golden in domestication, but often reverting to the natural color, when wild; 2 spinous and 18 soft rays in the dorsal and 2

spinous and 7 soft rays in the anal fin: Asia and Europe, first domesticated in China; in many ponds and streams in the eastern States.

**3. Campostoma** Agassiz. Body elongate; teeth with an oblique grinding surface and a slight hook; air bladder surrounded by numerous convolution of the very long alimentary canal, an anatomical feature found only in this genus of fishes: 4 species, 1 in Mexico.

**Key to the United States Species of Campostoma**

$a_1$ In the eastern and central parts of the country.....*C. anomalum.*
$a_2$ In Texas.....*C. formulosum.*
$a_3$ In Arizonia.....*C. ornatum.*

*C. anomalum* (Rafinesque). Stone roller. Length 200 mm. or less; head 4.2; depth 4.4; color brownish, with a brassy lustre and a dusky vertical bar behind the opercle; dorsal and anal fin each with a dark cross bar; male in spring with many tubercles; rays of dorsal fin 8; anal 7; scales 7-53-8: New York to Michigan, southward to Georgia and Texas; westward to Wyoming; abundant in small streams; herbivorous.

*C. formulosum* Girard. Head short, with a projecting snout; head 4; depth 4.5; color grayish, with a black spot at the base of the tail and one on the dorsal fin; scales 46: Texas, from the San Antonio to the Rio Grande.

*C. ornatum* Girard. Length 85 mm.; head 3.75; depth 4; color like *C. anomalum;* scales 10-75-9, 32 before the dorsal: southern Arizona; very common locally.

**4. Orthodon** Girard. Body elongate; teeth 6-6 or 6-5, compressed and nearly straight; scales very small; pseudobranchiæ absent: 1 species.

*O. microlepidotus* (Ayres). Length 375 mm.; head 4; depth 4.5; color olivaceous; rays of dorsal fin 9; anal 8; scales 21-105-12; teeth very long: basin of lower Sacramento and San Joaquin; abundant.

**5. Acrocheilus** Agassiz. Body elongate; teeth 4-5, hooked; jaws each with a conspicuous, broad, straight, horny plate; size rather large: 1 species.

*A. alutaceus* Agassiz & Pickering. Chisel-mouth. Length 300 mm.; head 4.5; depth 4; color very dark, body studded with minute dark points; rays of dorsal fin 10; anal 9; scales 20-85-16: basin of the lower Columbia, as far up as Spokane and Shoshone Falls; southeastern Oregon; abundant.

**6. Lavinia** Girard. Body elliptical, compressed, with a slender caudal peduncle; teeth 4-5 or 5-5, slightly hooked; size large: 1 species.

*L. exilicauda* Baird & Girard. Hitch. Length 300 mm.; head 4.6; depth 3.3; color dark, speckled, with silvery sides; rays of dorsal fin 10; anal 12; scales 13-64-18: Coast Range, from Monterey to Clear Lake; common.

**7. Chrosomus** Rafinesque. Body moderately elongate; size small; teeth 5-5 or 4-4, moderately hooked; scales minute; lateral line short or wanting: 4 species.

*C. erythrogaster* Raf. Red-bellied dace (Fig. 32). Length 75 mm.; head 4; depth 4; color brownish olive above, often with black spots; sides and belly silvery, with 2 black lateral bands, one running from the snout through the eye and curving down along the belly to a black spot in the tail; male in spring with yellow fins and bright scarlet belly;

FIG. 32.—*Chrosomus erythrogaster* (*from Fishes of Illinois*).

teeth 5-5; rays of dorsal fin 7; anal 8; scales 18-85-10: central New York and Pennsylvania to Dakota; southward to Alabama; common in clear, small streams; one of the brightest of the minnows.

*C. eos* Cope. Similar to *C. erythrogaster*, but with a slenderer body, the lateral line often wanting and the two lateral black bands uniting in the caudal peduncle: Susquehanna River.

*C. dakotensis* Evermann & Cox. Similar to *C. erythrogaster*, but smaller and stouter and without the black spot on the tail; rays of dorsal fin 8; anal 8; scales about 80, 24 in a cross series; teeth 4-4: Missouri River basin in Nebraska and South Dakota.

*C. oreas* Cope. Similar to *C. erythrogaster*, but with a somewhat different color pattern, the upper band ending in the caudal black spot, the lower band ending at the anal fin; scales 67: head waters of the Roanoke River; abundant.

**8. Hybognathus** Agassiz. Body elongate; teeth 4-4, with little or no hook; scales large; rays of both dorsal and anal fins usually 8; lateral line complete: 9 species, 2 in Mexico.

*H. nuchalis* Ag. Silvery minnow. Length 150 mm.; head 4.5; depth 5; color olivaceous green; sides silvery; rays of anal fin 7; scales 5-38-4, 12 to 14 scales before the dorsal fin: New York to the upper Missouri; southward to Georgia and Texas; common in large rivers.

*H. hayi* Jordan. Like *H. nuchalis*, but with a slenderer body; scales 5-36-3: lower Mississippi region, northward at least to Memphis.

*H. serena* (Girard). Length 60 mm.; color dusky with a black lateral band; scales 5-32 to 34-3; teeth hooked: western Texas.

*H. episcopa* (Girard). Length 75 mm.; color dusky, with a black lateral band; scales 9-37 to 41-4; teeth hooked: western Texas.

*H. nubila* (Forbes). Length 60; head 4.5; depth 4; color very dark with a dark lateral band; rays of anal fin 9; scales 5-37-3; teeth hooked: western Illinois to Wyoming; southward to the Ozarks; common.

FIG. 33.—*Pimephales notatus* (*from Fishes of Illinois*).

*H. plumbea* (Girard). Color uniform; rays of anal fin 7; scales 53 to 58; teeth hooked: Oklahoma, Arkansas River basin.

**9. Pimephales** Rafinesque. Teeth 4-4, one or more hooked; upper jaw protractile; dorsal fin over the ventrals, its first ray separated from the rest by a membrane; size small: 2 species.

*P. promelas* Raf. Fathead. Body stout; length 60 mm.; head and depth 4; color olivaceous; belly yellow; a dark lateral band; dorsal fin with a large black cross bar; male with a black head and with several large tubercles in the spring; lateral line variable, being nearly wanting or complete; rays of dorsal fin I,7; anal 7; scales 8 or 9-43 to 47-6; body short and deep: Lake Champlain to Montana, southward to Tennessee and the Rio Grande; common in sluggish brooks, especially in the Missouri basin.

*P. notatus* (Raf.). Blunt nose (Fig. 33). Length 100 mm.; head 4.5; depth 5; color olivaceous; sides bluish, with a dark stripe; a dark spot towards the base of the dorsal fin; rays of the dorsal fin I,8; anal 7; scales 6-45-4: Quebec to Dakota, southward to Alabama and Arkansas; very common in small streams west of the Alleghanies.

**10. Mylopharodon** Ayres. Body elongate; head large; teeth 2, 4-5, 2; mouth terminal, large; lips thickened; lateral line continuous; dorsal fin behind the ventrals; size very large: 1 species.

*M. conocephalus* (Baird & Girard). Length 900 mm.; head 3.5; depth 4.6; color dark, without red; rays of dorsal fin 8; anal 8; scales 17-74-7; body elongate, fusiform, compressed; caudal peduncle very long: Sacramento and San Joaquin Rivers; southeastern Oregon; not common.

**11. Mylocheilus** Agassiz. Body elongate; upper jaw protractile, with a small barbel on the maxillary; size large: 1 species.

*M. lateralis* Agassiz & Pickering. Whitefish; chub. Length 300 mm.; head 4.2; depth 4.5; color dark above and pale beneath; sides silvery, with two dark lateral bands enclosing a silvery band; teeth 1 or 2, 5-5, 2 or 1; rays of dorsal fin 8; scales 12-77-7: Oregon into British Columbia to the Fraser River; eastward to Flathead Lake; often enters the sea; abundant; a good food fish.

**12. Semotilus** Rafinesque. Body stout; head large; upper jaw protractile; a minute barbel on the maxillary just above its extremity; teeth 2, 5-4, 2, hooked; size large: 2 species.

*S. corporalis* (Mitchill). Fallfish; chub. Length 450 mm.; head and depth 4; color steel blue above; sides and belly silvery; males in spring with belly and fins red; rays of dorsal fin 8; anal 8; dorsal fin half way between nostril and tail fin; scales 8-45-4, about 22 before the dorsal fin: from Maine and the St. Lawrence to the James, east of the Alleghanies; common in swift streams and clear lakes; a game and food fish.

*S. atromaculatus* (Mitch.). Horned dace; common chub (Fig. 30). Length 250 mm.; head 3.75; depth 4; color dusky bluish; dorsal fin with a conspicuous black spot at its base and bordered by red in front in the male; teeth variable; rays of dorsal fin 8; anal 8; scales 9 to 11-55 to 69-5 to 7; dorsal fin midway between pupil and tail fin: from Maine to Wyoming; southward to Alabama; common, chiefly in small streams.

**13. Pogonichthys** Girard. Body elongate; maxillary with a barbel; caudal fin asymmetrical, the upper lobe being much the longer; size large: 1 species.

*P. macrolepidotus* (Ayres). Split-tail. Length 300 mm.; head 4.2; depth 3.75; teeth 2, 5-5, 2, hooked; color uniform, sides silvery; rays of dorsal fin 9; anal 8; scales 10-66-6: central California; common.

**14. Ptychocheilus** Agassiz. Body elongate; caudal peduncle stout; no barbels; teeth 2, 5-4, 2; scales small; lateral line decurved; size very large: 3 species.

**Key to the Species of Ptychocheilus**

$a_1$ On the Pacific slope.
  $b_1$ Dorsal rays 9 ..... *P. umpquæ.*
  $b_2$ Dorsal rays 10 ..... *P. oregonensis.*
  $b_3$ Dorsal rays 8 ..... *P. grandis.*
$a_2$ In the Colorado basin ..... *P. lucius.*

*P. oregonensis* (Richardson). Squawfish. Length up to 1,200 mm.; head 3.75; depth 5; color greenish; belly silvery; rays of dorsal fin 10; anal 8; scales 20-70: extreme northwest, ascending the Columbia and tributaries into Montana; common; a food and game fish.

*P. umpquæ* Snyder. Similar to *P. oregonensis;* scales 75 to 80: coastal streams of central Oregon.

*P. grandis* (Ayres). Similar to *P. oregonensis;* rays of dorsal fin 8; anal 8; scales 70 to 80: central and northern California; Oregon; common.

*P. lucius* Girard. White salmon. Length up to 1,500 mm.; weight up to 80 lbs.; head 3.5; depth 5.5; color uniform; rays of dorsal fin 9; anal 9; scales 83 to 90: Colorado basin; very common; the largest species in the family.

**15. Gila** Baird & Girard. Body elongate; caudal peduncle long and slender; tail widely forked; teeth 2, 5-4, 2, hooked; scales very small; dorsal fin behind the middle of the body; size large: 3 species.

*G. elegans* B. & G. Bony-tail. Length 300 mm.; head and depth 5; color bluish above; rays of dorsal fin 9; anal 10; scales 23-85-10; back arched; head short and broad: Colorado and Gila Rivers; abundant.

*G. robusta* B. & G. Roundtail. Length 400 mm.; head 4; depth 5; color plain; rays of dorsal fin 9; anal 9; scales 17-80-10: Colorado and Gila Rivers; very common.

**16. Leuciscus** Cuvier. Dace; chub. Body oblong; teeth usually 2, 5-4, 2, hooked; dorsal fin posterior; size small; colors often very bright; mouth terminal and usually large; no barbels; caudal peduncle stout; rays of dorsal and anal fins usually 8: one of the largest genera, being represented by species in North America, Asia and Europe; 15 species in the United States, mostly in the west.

**Key to the United States Species of Leuciscus**

$a_1$ In Pacific coast and Great Basin regions.
  $b_1$ In the Pacific coast States.
    $c_1$ In central California ..... *L. crassicauda.*
    $c_2$ In the Klamath Lakes ..... *L. bicolor.*
    $c_3$ In Puget Sound region and Columbia basin ..... *L. balteatus.*

$c_4$ In southern California.....*L. orcutti.*
$b_2$ In the Great Basin region.
$c_1$ Lateral line present.
$d_1$ Scales less than 65 in lateral line.
$e_1$ Rays of anal fin 8.....*L. lineatus*
$e_2$ Rays of anal fin 9.....*L. egregius.*
$e_3$ Rays of anal fin 10 to 13.....*L. hydrophlox.*
$d_2$ Scales very small, 80 in the lateral line.....*L. aliciæ.*
$c_2$ Lateral line absent.....*L. phlegethontis*
$b_3$ Along the Mexican border.....*L. niger.*
$a_2$ In the eastern and central States.
$b_1$ Lateral line complete.
$c_1$ In the southeastern States.....*L. vandoisulus.*
$c_2$ In the Great Lakes and upper Mississippi region.....*L. elongatus.*
$c_3$ In northern Minnesota.....*L. nachtriebi.*
$b_2$ Lateral line more or less incomplete.
$c_1$ Scales 80 in the lateral line.....*L. neogæus.*
$c_2$ Scales 52 to 58 in the lateral line.....*L. margarita.*
$c_3$ Scales 43 in the lateral line.....*L. flammeus.*

*L. crassicauda* (Baird & Girard). Length 300 mm.; head 4; depth 3; color brownish; scales 9-56-7; body short, compressed, deep: California, common in the Sacramento and San Joaquin.

*L. bicolor* (Girard). Length 300 mm.; head and depth 3.75; color dusky above, silvery below; scales 13-60-7; teeth 2, 5-5, 2; dorsal fin over ventrals: Klamath Lakes, Oregon.

*L. lineatus* (Gir.). Chub. Length 350 mm.; head and depth 3.5; color blackish, the scales dotted and with dark edges which form lines; rays of dorsal fin 9; scales 10-55 to 63-5; mouth very oblique: Great Basin of Utah; Yellowstone Park; Snake River basin; common.

*L. aliciæ* (Jouy). Length 150 mm.; head 4.25; depth 3.75; color bluish olive above; sides silvery; scales very small, 19-80-12: Great Basin of Utah; very common.

*L. niger* (Cope). Length 300 mm.; head and depth 3.75; color dusky above; scales 80: Rio Grande basin and the Mexican border.

*L. egregius* (Gir.). Length 85; head 3.6; depth 4.25; color blackish with 2 parallel, lateral dark bands separated by a light one which meet on the caudal peduncle, and a broad red band; belly golden, reddish in male; rays of anal fin 9; scales 12 or 13-52 to 56-6 to 8: northern Nevada; very common in Lake Tahoe.

*L. hydrophlox* (Cope). Length 125; head 4.3; depth 4; color dusky, with a dark lateral band between 2 silvery ones; in males the dark band and belly being red; rays of dorsal fin 9; anal 10 to 13; scales 12-58-5: Salt Lake basin; Snake River; very common.

*L. balteatus* (Richardson). Length 150 mm.; head 4.5; depth 3.25; color plain, usually with a dark lateral band; rays of dorsal fin 10; anal 11 to 22; scales 13-55 to 63-6; body compressed: Columbia basin and streams entering Puget Sound; southeastern Oregon; eastward to Montana; common.

*L. vandoisulus* Cuvier & Valenciennes. Length 125 mm.; head 3.6; depth 4.75; color bluish green, mottled; a dark lateral band; males in spring bright red anteriorly; rays of dorsal fin 9; scales 48 to 53: streams about Chesapeake Bay to Georgia; common in clear, swift streams.

*L. neogæus* (Cope). Length 75 mm.; head 4; depth 4.25; color dusky above, with a dark lateral band; in spring belly and lower fins crimson in males; lateral line incomplete; teeth 2, 4-5, 2; scales 18-80-10; head very large: region of the Great Lakes and upper Mississippi Valley; rare.

*L. elongatus* (Kirtland). Shiner. Length 125 mm.; head 4; depth 5; color dark bluish, mottled with paler; a broad black lateral band, the anterior half of which is crimson in the spring in males; rays of anal fin 9; scales 10-70-5; head long; mouth large: region of the Great Lakes and upper Mississippi Valley; common in clear streams northwards.

*L. margarita* (Cope). Length 75 mm.; head 4; depth 4.25; color dusky olive above; sides silvery; belly white, crimson in spring males; rays of anal fin 9; scales punctate, 11-52 to 58-8; lateral line more or less incomplete; snout very blunt: Susquehanna to the James; not common.

*L. flammeus* (Jordan & Gilbert). Length 60 mm.; head and depth 4; color dark above; a black lateral band; males scarlet in spring; a small black spot at base of tail; scales 7-43-5; lateral line very short: basin of the Tennessee; common in northern Alabama.

*L. orcutti* (Eigenmann). Head 3.5; depth 4; color dark gray, with a faint plumbeous lateral band; rays of anal fin 7: rivers of southern California tributary to the Pacific; abundant.

*L. nachtriebi* Cox. Length 100 mm.; head 4.25; depth 5; color dusky; scales 12-79-9; teeth 2, 4-5, 2; lateral line complete: northern Minnesota.

*L. phlegethontis* (Cope). Length 35 mm.; head 3.75; depth 3.3; color olivaceous, with a dark lateral band; belly golden; rays of dorsal fin 7; scales 6-36-4, 17 before the dorsal fin; teeth 1, 5-4, 2; lateral line absent: basin of Great Salt and Sevier Lakes; very common; the smallest of the family.

**17. Rutilus** Rafinesque. Roaches. Body stout, somewhat compressed, mouth oblique; no barbels; size moderate; teeth 4-5, 5-5 or 6-5; rays of dorsal and anal fins usually 8: numerous species in America, Europe and Asia; 6 species in the United States, all in the extreme west.

*R. olivaceus* (Cope). Length 300 mm.; head 4; depth 4.3; teeth 5-5; body slender, compressed; color dusky olive above; body and fins dotted with black; scales 11-56-6: Lake Tahoe and Pyramid Lake; very common.

*R. bicolor* (Girard). Length 200 mm.; head 4; depth 4.5; color olivaceous with a bluish lateral band; body with some brown spots; rays of anal fin 7; scales 9-48-6; teeth 4-5: Lakes of southeastern Oregon; common.

*R. thalassinus* (Cope). Similar to *R. bicolor*, but with a larger head and longer fins: southeastern Oregon.

*R. oregonensis* Snyder. Length 200 mm.; head and depth 3.6; color dark; scales 13-52-8: southeastern Oregon.

*R. columbianus* Snyder. Length 136 mm.; head and depth 3.7; color silvery, dark above; scales 12-49-7: southeastern Oregon.

**18. Hesperoleucus** Snyder. Similar to *Rutilus*, but with a shorter head and a slenderer body: several species, all near San Francisco Bay.

*H. symmetricus* (Baird & Girard). Length 125 mm.; head 3.75; depth 4.2; color dusky above; sides pale, more or less dotted with black and sometimes with a dark lateral band; rays of dorsal and anal fins 8; teeth 5-4; scales 14-52 to 67-5; body rather elongate: central and northern California, Oregon, Nevada and Utah.

*H. venustus* Snyder. Length 100 mm.; head and depth about 4; color silvery, with a narrow lateral stripe; rays of dorsal fin 9; anal 8; scales 53: in streams entering San Francisco and San Pablo Bays.

*H. navarroensis* Snyder. Length 90 mm.; head and depth 3.6; color dark above, silvery below, with a narrow lateral stripe; rays of dorsal and anal fins 8; scales 56: Navarro basin, northern California.

*H. parvipinnis* Snyder. Length 80 mm.; head and depth 3.9; scales 59; rays of dorsal fin 8; anal 7: Gualala River basin, California.

*H. mitrulus* Snyder. Length 84 mm.; head and depth 4.7; rays of dorsal fin 8; anal 7; scales 60: Goose Lake, California.

*H. subditus* Snyder. Length 110 mm.; head 3.8; depth 3.6; rays of dorsal fin 8; anal 7; scales 53: streams flowing into San Francisco Bay.

**19. Luxilinus** Jordan. Similar to *Abramis*, but not carinated ventrally and fully scaled: 1 species.

*L. occidentalis* (Baird & Girard) Body elongate; color brownish above; rays of dorsal fin 10; anal 11; sides silvery speckled: San Joaquin basin, California.

**20. Opsopæodus** Hay. Mouth very small, terminal; teeth 5-5 or 4-5, strongly hooked; upper jaw protractile; size small: 2 species.

*O. emiliæ* Hay. Length 55 mm.; head 4.5; depth 4.4; color yellowish; sides silvery, with usually a dark lateral band; a black spot on hinder part of dorsal fin; rays of dorsal fin 9; anal 8; scales 6-40-4; mouth very oblique; body elongate, compressed: Lake Erie to Georgia and Mississippi; common towards the south in sandy lowland streams.

*O. bollmani* Gilbert. Length 50 mm.; head 4.4; depth 4.6; color dark olive, with a black lateral band and a large spot at the base of the tail; rays of the dorsal and anal fins 8; scales 5-37-4; mouth slightly oblique; lateral line on but 7 or 8 scales: Georgia and Tennessee; scarce.

**21. Abramis** Cuvier. Breams. Body elliptical, strongly compressed, the belly forming a keel behind the ventral fins which is naked;

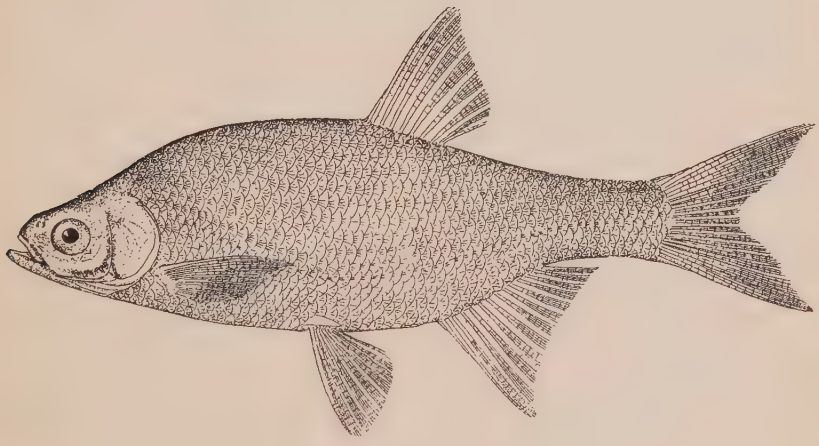


Fig. 34.—*Abramis crysoleucas (from Jordan & Evermann).*

teeth 5-5, hooked; no barbels; dorsal fin behind the ventrals: Europe and America; 1 species in the United States.

*A. crysoleucas* (Mitchill). Golden shiner (Fig. 34). Length 300 mm.; head 4.5; depth 3; color clear greenish above; sides silvery, with golden reflections; fins yellowish; rays of dorsal fin 8; anal 11 to 14; scales 10-46 to 55-3; mouth small, oblique; lateral line decurved: Nova Scotia to Dakota, southward to Tennessee and Texas; very common in weedy ponds and streams.

*Subspecies of A. crysoleucas*

*A. c. bosci* (Cuvier & Valenciennes). Rays of anal fin 16; scales 8-43-2; lower fins scarlet in males: south Atlantic States.

**22. Cliola** Girard. Body stout; teeth 4-4; dorsal fin over ventrals and with its first ray separated from the rest by a membrane: 2 species.

*C. vigilax* (Baird & Girard). Bullhead minnow. Length 75 mm.; head 4.25; depth 4.5; color dusky olive or yellowish with a dark lateral band which terminates with a black spot; dorsal fin with 8 rays, on each of which is a black spot; anal rays 7; scales 8-42-6, 28 before the dorsal: Ohio to Iowa, southward to Georgia and Texas; very common.

**23. Notropis** Rafinesque. Shiners. Body elongate or oblong, more or less compressed; teeth in 1 or 2 rows, the main row 4-4, usually hooked; rays of dorsal fin mostly 8; anal 7 or 8; no barbels; lateral line usually complete; dorsal fin above or behind the ventrals; size small; tail deeply forked; coloration silvery, often with reds and blues: about 100 species, all in North American and in the eastern and central States; small, often brightly colored fishes which abound in every clear brook, especially in the southern States.

### Key to the Species of Notropis

$a_1$ Teeth in 1 row, 4-4; in the eastern and north-central States.
  $b_1$ In the Atlantic States.
    $c_1$ On the Atlantic slope.
      $d_1$ Lateral line very short; Massachusetts to Maryland. *N. bifrenatus.*
      $d_2$ Lateral line complete; Delaware River to the Neuse. *N. procne.*
      $d_3$ In Florida. *N. welaka.*
    $c_2$ In the Ohio River basin.
      $d_1$ Without a black spot at the base of the tail fin. *N. kanawha.*
      $d_2$ Conspicuous black spot at base of tail fin. *N. spectrunculus.*
  $b_2$ In the central States.
    $c_1$ Lateral line usually more or less incomplete, New York and westwards.
      $d_1$ Dark caudal spot present.
        $e_1$ Chin black. *N. anogenus.*
        $e_2$ Chin pale. *N. cayuga.*
      $d_2$ No caudal spot present. *N. heterodon.*
    $c_2$ Lateral line complete.
      $d_1$ Scales not deeper than long or closely imbricated.
        $e_1$ No black caudal spot; in the central States.
          $f_1$ Mouth horizontal. *N. blennius.*
          $f_2$ Mouth somewhat oblique. *N. scylla.*
        $e_2$ A small caudal spot; South Dakota and southwards. *N. topeka.*
      $d_2$ Scales deeper than long and closely imbricated. *N. lutrensis.*
$a_2$ Teeth in 2 rows, either 1, 4-4, 1 or 2, 4-4, 2.
  $b_1$ Teeth 1, 4-4, 1; mostly in the southern and south-central States.
    $c_1$ Scales usually not closely imbricated or deeper than long; in the central States.

$d_1$ No caudal spot present.
$e_1$ Anal fin with 9 rays; in Iowa and Colorado.....*N. gilberti.*
$e_2$ Anal fin with 8 rays.
$f_1$ In Texas.....*N. nocomis.*
$f_2$ From Lake Erie to Arkansas.....*N. illecebrosus.*
$e_3$ Anal fin with 7 rays; Ohio basin and Iowa.....*N. shumardi.*
$d_2$ A black caudal spot present; eastern and central States.....*N. hudsonius.*
$c_2$ Scales deeper than long and closely imbricated; in the south, southwest and west.
$d_1$ Rays of anal fin 7 to 9.
$e_1$ Dorsal fin without large black blotch.
$f_1$ No black spot at base of tail fin; in Kansas and southwestwards.
$g_1$ Body short; back arched.....*N. bubalinus.*
$g_2$ Body long and slender; back not arched..*N. macrostomus.*
$f_2$ A black spot at base of tail fin; in Texas.
$g_1$ Rays of anal fin 8.....*N. texanus.*
$g_2$ Rays of anal fin 7.....*N. notatus.*
$e_2$ Dorsal fin with a large black blotch.
$f_1$ A black blotch at base of tail fin; on the Gulf slope.
$g_1$ Fins of male without red.
$h_1$ Scales in lateral line 42 to 44.....*N. stigmaturus.*
$h_2$ Scales in lateral line 37 to 39.....*N. cercostigma.*
$g_2$ Fins of male reddish.
$h_1$ Scales in lateral line 42.....*N. trichroistius.*
$h_2$ Scales in lateral line 40.....*N. callistius.*
$h_3$ Scales in lateral line 39.....*N. eurystomus.*
$f_2$ No black blotch at base of tail fin.
$g_1$ Rays of anal fin 8.
$h_1$ In the Alabama basin.....*N. cæruleus.*
$h_2$ In the eastern and central States.....*N. whipplii.*
$h_3$ In the south-central States.....*N. galacturus.*
$g_2$ Rays of anal fin 9; in the Arkansas River basin.....*N. camurus.*
$d_2$ Rays of anal fin 10 to 11; in the southeastern States.
$e_1$ A dark spot at base of tail fin.
$f_1$ Rays of anal fin 10.....*N. xænurus.*
$f_2$ Rays of anal fin 11.....*N. hypselopterus.*
$e_2$ No dark spot at base of tail fin.....*N. pyrrhomelus.*
$b_2$ Teeth 2, 4-4, 2.
$c_1$ Rays of anal fin 7 to 10; mostly in the southeastern States.
$d_1$ Scales mostly closely imbricated and crowded.
$e_1$ Dorsal fin over the ventrals; size large.
$f_1$ In the eastern and central States.....*N. cornutus.*
$f_2$ In Virginia.....*N. cerasinus.*
*N. albeolus.*

$e_2$ Dorsal fin behind the ventrals.
$f_1$ Lower jaw projecting; southern Alleghanies.
$g_1$ Fins plain in color.....*N. macdonaldi.*
$g_2$ Upper half of dorsal and caudal fins dark.*N. coccogenis.*
$f_2$ Lower jaw not projecting.
$g_1$ No black at base of tail fin.
$h_1$ Rays of anal fin 9.
$i_1$ In the Ozark region.....*N. zonatus.*
$i_2$ In the southern Alleghenies.....*N. rubricroceus.*
$h_2$ Rays of anal fin 10.
$i_1$ In Georgia.....*N. zonistus.*
$i_2$ In Illinois.....*N. pilsbryi.*
$h_3$ Rays of anal fin 8; in the Carolinas..*N. chlorocephalus.*
*N. lutipinnis.*
$g_2$ A black spot at base of tail fin; in the southern States.
$h_1$ Rays of anal fin 8.....*N. chiliticus.*
*N. chalybæus.*
*N. chrosomus.*
$h_2$ Rays of anal fin 9.....*N. altipinnis.*
$h_3$ Rays of anal fin 7.....*N. roseus.*
*N. xænocephalus.*
$d_2$ Scales not closely imbricated; in the central States.
$e_1$ Dorsal fin over the ventrals; no caudal spot.
$f_1$ Rays of anal fin 9.....*N. ariommus.*
$f_2$ Rays of anal fin 7.....*N. jejunus.*
$e_2$ Dorsal fin behind ventrals; a black caudal spot present.....*N. leuciodus.*
$c_2$ Rays of anal fin 11 or 12; dorsal fin behind ventrals.
$d_1$ No black on dorsal fin.
$e_1$ Rays of anal fin 10.....*N. telescopus.*
*N. stilbius.*
*N. rubifrons.*
*N. photogenis.*
*N. scepticus.*
*N. micropteryx.*
$e_2$ Rays of anal fin 11.....*N. atherinoides.*
*N. dilectus.*
*N. metallicus.*
$d_2$ A black spot present on dorsal fin.
$e_1$ Spot indistinct, consisting of a few dots.....*N. lirus.*
$e_2$ Spot distinct.
$f_1$ Spot on upper portion of fin; in the Gulf States.....*N. roseipinnis.*
$f_2$ Spot at base of fin; in the central and southern States.....*N. umbratilis.*

*N. bifrenatus* (Cope). Length 50 mm.; head and depth 4.2; straw-color, with a black lateral band bordered by orange on the snout;

scales 5-36-3, 13 before the dorsal fin; body slender, lateral line very short; snout very obtuse: Massachusetts to Maryland, in coastal streams; not common.

*N. anogenus* Forbes. Length 35 mm.; head 4.25; depth 4; color dusky with a dark lateral band through the eye ending in a black spot at the base of the tail fin; mouth very small and oblique; chin black; snout obtuse; scales 34 to 37: western New York to northern Illinois; scarce.

*N. cayuga* Meek (Fig. 35). Length 60 mm.; head 4.5; depth 4.5; color olivaceous, with a black stripe through the snout and eye, a dusky lateral shade and a small caudal spot; belly yellow; scales

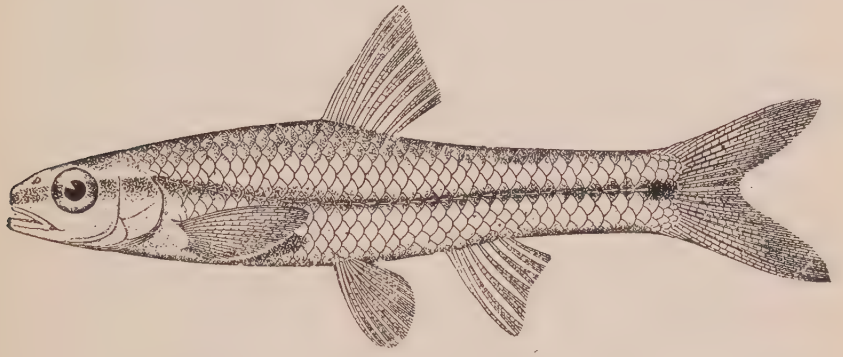


FIG. 35.—*Notropis cayuga* (*from Jordan & Evermann*).

36, 14 before the dorsal fin; mouth very small: northern New York to South Dakota; southward to Texas; not rare.

*N. welaka* Evermann & Kendall. Head 4.2; depth 5; color olivaceous, with a broad black lateral band extending from the snout to a black spot at the base of the tail fin; scales 6-35-3: St. Johns River, Florida; abundant.

*N. heterodon* (Cope). Length 60 mm.; head 4; depth 4; color olivaceous; chin black; sides with a dusky band; scales 5-36-3, 13 before the dorsal fin; snout pointed; body stout: western New York to Kansas; common.

*N. blennius* (Girard). Length 60 mm.; head 4; depth 5; color pale olivaceous, with sometimes a darker lateral stripe; scales 5-32 to 38-4, 15 before the dorsal fin; mouth small, horizontal; snout obtuse: Great Lakes region to Dakota; southward to Tennessee and Texas; abundant in small streams.

*N. scylla* (Cope). Length 70 mm.; head 4; depth 4.25; color pale; back greenish; rays of dorsal fin 7; anal 7; scales 31 to 33; body

stout; mouth oblique: Illinois River to Montana; southward to Kansas; common in shallow, sandy streams.

*N. procne* (Cope). Length 60 mm.; head 4.75; depth 5.25; color olivaceous, with a dark lateral band; scales 5-32 to 34-3, 13 before the dorsal fin; rays of anal fin 7; body slender: Delaware River to the Neuse, in coastal streams; very common.

*N. kanawha* Jordan & Jenkins. Length 85 mm.; head 4.4; depth 4.6; color translucent green; sides silvery; rays of anal fin 9; scales 4-37-2, 16 before the dorsal: tributaries of the Kanawha River, Virginia.

*N. spectrunculus* (Cope). Length 75 mm.; head 4; depth 5.5; color pale olive; silvery white below; a dark band along the sides and a conspicuous black spot at the base of the tail fin; rays of anal fin 9; scales 37, 15 before the dorsal fin: head waters of the Tennessee River; very common.

*N. topeka* Gilbert. Length 90 mm.; head 4; depth 3.6; color olivaceous, with a dusky lateral band ending in a small caudal spot; males in spring and summer with sides and lower fins bright red; scales 5-35-4, 14 before the dorsal fin: western Iowa and eastern South Dakota to Kansas; common.

*N. gilberti* Jordan & Meek. Length 60 mm.; head 4; depth 5; color light olive with dusky streaks and specks; rays of anal fin 9; scales 5-35-4, 17 before the dorsal fin; body slender: western Illinois to eastern Colorado; common in muddy streams.

*N. nocomis* Evermann. Length 60 mm.; head 4.3; depth 5; color yellowish, with dark specks and a dark lateral band; scales 6-36-3; teeth 1, 4-4, 1; eyes large: Trinity, San Marco and Comal Rivers, Texas; common.

*N. shumardi* (Gir.). Length 75 mm.; head 3.75; depth 4.2; color olivaceous with dusky streaks and dark specks; eyes very large; scales 5-36-2, 12 before the dorsal fin; rays of anal fin 7: Ohio and Tennessee basins to Iowa and the Ozark region; common towards the south in cold streams.

*N. hudsonius* (Dewit Clinton). Spot-tail; shiner. Length 150 mm.; head 4.75; depth 4; color very pale; sides with a broad silvery band; usually a black spot at the base of tail fin; teeth 1 or 2, 4-4, 0, 1 or 2; scales 5-39-4, 18 before the dorsal fin; body elongate; head short; muzzle blunt: Dakota to New England; southward in coastwise streams to Georgia; in large rivers and lakes; abundant in the Great Lakes; very variable.

*N. lutrensis* (Baird & Girard). Redfin. Length 75 mm.; head 3.6; depth 3 to 4; color of male steel blue; male tuberculate in spring

with belly and fins red; a conspicuous violet crescent behind the shoulder; females plain greenish; scales 6-35-3 or 4; back arched; body compressed: southern Illinois to Dakota; southward to the Rio Grande; very common in clear brooks southward.

*N. bubalinus* (B. & G.). Length 85; head 4.1; depth 3; color plain; rays of anal fin 9; scales 32 to 35: Arkansas and westward; not common.

*N. illecebrosus* (Gir.). Length 75 mm.; head 4.3; depth 4; straw-color with a broad silvery lateral band; eyes very large; scales 5-35-3; teeth 1, 4-4, 1: Lake Erie basin and Ohio River to Arkansas and Missouri.

*N. macrostomus* (Gir.). Head 4; depth 4.1; color brownish; sides silvery; teeth 1, 4-4, 1; rays of anal fin 9; scales 36: Kansas to the Rio Grande.

*N. texanus* (Gir.). Length 50 mm.; head 4; depth 4.5; color silvery, with dark points along the lateral line and a small black caudal spot; scales 5-35-4: from the Trinity to the Salado Rivers, Texas.

*N. notatus* (Gir.). Head 4; depth 3.6; color plain, with a black caudal spot; scales 5-35-3; dorsal fin behind ventrals; body stoutish: Texas from Austin westward.

*N. stigmaturus* (Jord.). Spotted tail. Length 110 mm.; head 4.5; depth 4.75; color pale olive with a large black spot at the base of the tail fin; scales 7-42 to 44-3, 20 before the dorsal fin; body elongate; a large blotch on the dorsal fin: Alabama basin; very common.

*N. cercostigma* (Cope). Like *N. stigmaturus* except that there are 37 to 39 scales in the lateral line: sandy streams tributary to the Gulf, from the Pearl to the Nueces Rivers; abundant.

*N. trichroistius* (Jordan & Gilbert). Length 85 mm.; head 4.1; depth 4.25; color steel blue above; sides white, with a large black spot at the base of the tail fin; dorsal fin red with white tips and a broad dusky band at its base; belly and lower fins white; scales 6-42-3: Alabama basin; common.

*N. callistius* (Jord.). Length 100 mm.; head 4.2; depth 4.6; color very dark blue; sides silvery violet, with a reddish lateral band; belly and lower fins white; dorsal and caudal fins red, with a white tip; caudal spot present; scales 5-40-3: Alabama basin.

*N. eurystomus* (Jord.). Length 100 mm.; head 4.25; depth 4.3; color olivaceous; sides silvery, with a black caudal spot; belly and lower fins white; scales 6-39-3: basin of the Chattahoochee River.

*N. cæruleus* (Jord.). Length 75 mm.; head 4.3; depth 4.6; color steel blue; sides and belly white, with a lateral blue-green band and a

spot at the base of the tail fin; fins bright yellow with white tips; scales 6-38-3: Alabama basin; common.

*N. whipplii* (Gir.) Silver-fin. Length 100 mm.; head 4.3; depth 4.6; color silvery, being bluish in the male; edges of scales dusky; a large black spot on the upper posterior part of the dorsal fin; paired fins white; scales 5-35 to 40-3: Lakes Champlain and Oregon to Minnesota; southward to Alabama and Arkansas; abundant in clear streams.

*N. galacturus* (Cope). Length 150 mm.; head and depth 4.3; color steel blue above; a black blotch on the hinder rays of the dorsal fin; caudal fin yellow at base; scales 6-41-3: Ozark region to Georgia and South Carolina; abundant in mountain streams.

*N. camurus* (J. & M.). Length 100 mm.; head 4.3; depth 3.5; color as in *N. whipplii;* rays of anal fin 9; scales 6-38-4: Arkansas, Kansas and southwestern Missouri; not rare.

*N. xænurus* (Jord.). Length 75 mm.; head 4; depth 3.75; color steel blue; a faint caudal spot; fins crimson in males; upper hinder part of dorsal fin black; rays of anal fin 10; scales 6-39-3: Altamaha basin, Georgia; common.

*N. hypselopterus* (Günther). Length 60 mm.; head 4.25; depth 4; color silvery; dorsal and anal fins very high, the former with a black blotch posteriorly, the latter with 11 rays; a black spot at the base of the tail fin; scales 6-35-3: southern Georgia and Alabama.

*N. pyrrhomelas* (Cope). Length 80 mm.; head 4; depth 3.75; color dark steel blue, abruptly white below; head reddish; dorsal fin very high, dusky at base, with a black blotch above and red in front; anal fin large and with 10 rays; tail fin very broad, pale at base and tip and with dark and scarlet cross bands; scales 6-35-3: Santee basin, South Carolina; very common.

*N. cornutus* (Mitchill). Common shiner; redfin; dace (Fig. 36). Length 125 to 200 mm.; head 4; depth 3.3 to 4.4; teeth 2, 4-4, 2; color dark steel blue above, silvery on the sides and belly; forward part of body tuberculate and lower fins and belly salmon pink in spring males; a dark shade behind the shoulder; rays of anal fin 9; scales 6-37 to 40-3; body short, compressed; lateral line decurved: entire region east of the Rockies except the Atlantic coast region south of the Neuse River and Texas; very common in small streams; very variable.

*N. cerasinus* (Cope). Shiner. Length 100 mm.; scales 6-37-3; sides marked with irregular cross bars, otherwise like *N. cornutus;* colors very brilliant: basin of the Roanoke, in mountain brooks.

*N. albeolus* Jord. Length 175 mm.; like *N. cornutus*, but with paler colors; scales 38: Roanoke, Tar and Neuse Rivers; not in mountain streams.

*N. macdonaldi* Jord. & Jen. Length 125 mm.; head 3.75; depth 4.75; teeth 2, 4-4, 2; color greenish; rays of anal fin 9 or 10; scales 7-39-2; mouth large, the lower jaw projecting: basin of the James and Shenandoah Rivers; in mountain streams; common.

*N. coccogenis* (Cope). Length 125 mm.; head 4; depth 4.25; color olivaceous, rosy in spring males; a vertical scarlet bar on the preopercle;

FIG. 36.—*Notropis cornutus* (*from Fishes of Illinois.*)

lower jaw projecting; upper half of dorsal and caudal fins dark; scales 7-42-3: mountain streams from Kentucky to Georgia; common.

*N. zonatus* (Agassiz). Length 125 mm.; head 4.25; depth 4.6; color olivaceous, with a dark lateral line; male in spring with red belly and sides; rays of anal fin 9; scales 6-42-4: mountain streams in Tennessee and the Ozarks; common.

*N. zonistius* (Jord.). Length 100 mm.; head 3.8; depth 3.6; color steel blue above, with a round black spot at the base of the tail fin; dorsal fin with a black bar; tail reddish; opercle with a faint red bar and shoulder with a black bar; rays of anal fin 10; scales 7-40-3; teeth 2, 4-4,2: Chattahoochee River basin.

*N. rubricroceus* (Cope). Red fallfish. Length 100 mm.; head 4; depth 4.5; color steel blue, with a dark lateral band; fin all red; head pale red; in high coloration the whole body more or less red; rays of anal fin 9; scales 7-38-3: head waters of the Tennessee and Savannah Rivers.

*N. chlorocephalus* (Cope). Length 60 mm.; head 4; depth 5; color olivaceous, with black specks which form a lateral band ending in a

dusky spot at the base of the tail fin; upper part of the head metallic green; belly in males red; scales 6-39-3: Santee basin; common in mountain streams.

*N. lutipinnis* (Jordan & Brayton). Length 75 mm.; head 4; depth 4.25; color olive, with intense green lines and a metallic blackish lateral band; head and fins bright yellow; males red; scales 7-40-3: South Carolina and Georgia; in pine woods.

*N. chiliticus* (Cope). Length 50 mm.; head 4; depth 5.5; color olivaceous, with a silvery lateral band; dorsal and anal fins each with a vermilion band; a dark caudal spot; scales 7-36-2: basin of the Great Pedee River; common in upland streams.

*N. altipinnis* (Cope). Length 60 mm.; head 4.3; depth 3.5; color greenish, with a silvery lateral band and a black band across the eye and snout; lower jaw blackish; rays of anal fin 9; scales 5-36-2: basin of the Great Pedee and Cape Fear Rivers; in pine woods; common.

*N. roseus* (Jord.). Length 60 mm.; head 4.3; depth 4.5; color olivaceous, with a dark lateral line; fins red in male; top of head red; rays of anal fin always 7; scales 5-38-5; body short and stout; a dark caudal spot: lowland streams of the Gulf States from the Ogeechee to the Mississippi; common.

*N. chalybæus* (Cope). Length 50 mm.; head 3.8; depth 5; color dark, with a broad lateral band; belly straw color, orange in spring males; a small dark caudal spot; scales 6-33-3; body slender; mouth very oblique: Ogeechee River to the Delaware, in coastal streams and swamps; scarce.

*N. chrosomus* (Jord.); Length 60 mm.; head 4.3; depth 5; color greenish; belly silvery; a scarlet bar across the dorsal, anal and the base of the caudal fins; a narrow scarlet lateral band; a small black spot at base of tail fin; scales 5-37-3: Alabama basin; very common.

*N. xænocephalus* (Jord.). Length 70 mm.; head 4.2; depth 5; color dark olivaceous, with a dark band along the sides of the caudal peduncle and the head and a dusky blotch at the base of the tail fin; males without red; rays of anal fin 7; scales 5-38-3: Georgia to Mississippi; common in pine woods; descending to the sea.

*N. ariommus* (Cope). Length 125 mm.; head 3.75; depth 4.25; color olivaceous; rays of anal fin 9; scales 6-39-2; eyes very large: basin of the Ohio and Tennessee Rivers; common about Indianapolis.

*N. jejunus* (Forbes). Length 75 mm.; head 4; depth 4.6; color pale, with a broad silvery lateral band; rays of anal fin 7; scales 5-37-3; teeth 2, 4-4, 1: western Pennsylvania to Kansas; southward to Tennessee northward to Winnipeg; not rare.

*N. leuciodus* (Cope). Length 75 mm.; head 4.5; depth 5; color olivaceous; sides silvery, with a purplish lateral band; a black spot at base of tail fin; scales 5-39-3: basin of the upper Tennessee; very common not in mountain streams.

*N. telescopus* (Cope). Length 100 mm.; head 4.25; depth 4.75; color pale greenish, the scales dark edged; rays of anal fin 10; scales 5-35 to 38-3; mouth very oblique; eyes very large: basin of the upper Tennessee, in cold streams; very common; also in Arkansas.

*N. stilbius* Jord. Length 75 mm.; head 4.2; depth 5; color pale green; sides with a broad silvery band and numerous dark dots which form a blotch at the base of the tail fin; rays of anal fin 10; scales 5-37-2; teeth 2, 4-4, 1; eyes very large: Tennessee and Alabama; common.

*N. pilsbryi* Fowler. Length 70 mm.; head 4; depth 4; color olive, the scales finely speckled above the lateral line; rays of anal fin 10; scales 6-37-3 or 4: Illinois.

*N. atherinoides* Raf. Length 150 mm.; head 4.6 depth 5.5; color translucent green; sides silvery; rays of anal fin 11; scales 5-38-3; body long and slender; mouth very oblique; eyes very large: Great Lakes region and Ohio and Mississippi Valleys; northward to Winnipeg; common in lakes and river channels.

*N. dilectus* (Gir.). Length 85 mm.; head 4.6; depth 4.5; color very pale; snout and base of fins rosy; rays of anal fin 11; scales 7-38-3; body elongate; mouth oblique: basin of the Ohio to the Rio Grande; common.

*N. rubrifrons* (Cope). Length 70 mm.; head 4; depth 5; color olivaceous; sides silvery; rays of anal fin 10; scales 6-39-3; mouth very oblique: New York and western Pennsylvania to southern Michigan; southward to Kentucky and Kansas; very common in clear streams, especially in the Ohio Valley.

*N. photogenis* (Cope). Length 75 mm.; head 4.25; depth 5.5; color olivaceous; sides and belly silvery, with dark specks along the lateral line rays; rays of anal fin 10; scales 6-40-3, 25 before the dorsal fin: basin of the Youghiogheny and Kanawha Rivers, and southward; common in clear streams.

*N. scepticus* (J. & G.). Length 75 mm.; head 3.75; depth 4.5; color pale green; sides with a silvery band; rays of anal fin 10; scales 6-38-3, 14 before the dorsal fin; eyes very large: the Cape Fear to the Santee Rivers; common.

*N. micropteryx* (Cope). Length 70 mm.; head 4.5; depth 5.5; color olivaceous; sides silvery, with a dusky blotch at the base of the tail fin; rays of anal fin 10; scales 5-38-2; body very slender, compressed; mouth

large, oblique: head waters of the Cumberland and Tennessee Rivers; also in the Ozark region; common.

*N. metallicus* J. & M. Length 45 mm.; head 4; depth 5; color dark brown, with a rosy band from the eye to the upper lobe of the tail, below which is a metallic dusky band ending in a broad black spot at the base of the tail fin; rays of anal fin 11; scales 5-35-3: swamps and streams in southern Georgia and northern Florida.

*N. lirus* Jord. Length 60 mm.; head 4.3; depth 5.25; color pale green; sides with a metallic blue band formed of dark dots; fins red in males; rays of anal fin 10; scales 8-45-4: basin of the Tennessee and Alabama Rivers; common in sandy streams.

*N. roseipinnis* (Hay). Length 85 mm.; head 4.5; depth 4; color dark, the scales above having dark dots; a dark lateral band; vertical fins red; rays of anal fin 11; scales 8-45-3; body slender, compressed; a black spot on the dorsal and anal fins: tributaries of the Gulf from Mississippi to Florida.

*N. umbratilis* (Gir.). Redfin. Length 75 mm.; head 4.25; depth 4 to 4.5; color steel blue above; pale beneath; a dark spot at the base of the dorsal fin; male in the spring with belly and lower fins brick red and with white tubercles covering the anterior portion of the body; rays of dorsal fin 7; anal fin 11; scales 9-40 to 52-3; body stout, compressed; caudal peduncle long: western New York to Minnesota; southward to Alabama and Kansas; common in small clear streams.

*Subspecies of N. umbratilis*

*N. u. umbratilis* (Gir.). Dorsal fin with 8 rays; scales 40 to 44: Arkansas, Kansas and southwestern Iowa.

*N. u. atripes* (Jord.). Blackfin. Dorsal and anal fins each with a black bar across its upper part: southern Illinois and Iowa.

*N. u. lythrurus* (Jord.). Scales in lateral line 47: basin of the Ohio River.

*N. u. cyanocephalus* (Copeland). Dorsal fin with 8 rays; anal 12; scales 9-46-4; top of head blue: southern Wisconsin.

*N. u. ardens* (Cope). Fins bright red: Roanoke River.

*N. u. matutinus* (Cope). Rays of dorsal fin 8; scales 7-44-3; colors pale; body slender; males with snout, chin and upper half of dorsal fin red; a dark caudal spot: Neuse and Pimlico Rivers; common.

*N. u. punctulatus* (Hay). Rays of dorsal fin 8; anal 10 or 11; scales 11-49-3; body straw-color; length 50 mm.: northern Mississippi.

*N. u. fasciolaris* Gilbert. Males with 5 to 8 dark blue vertical bars: basin of the southern bend of the Tennessee River; common.

**24. Ericymba** Cope. Body elongate; teeth 1, 4-4, 0, hooked; scales large; dorsal fin above ventrals; eyes very large; dentaries, interopercles and suborbitals broad and with conspicuous mucous channels: 1 species.

*E. buccata* Cope. Length 100 mm.; head 4; depth 5; color olivaceous, with silvery sides; rays of dorsal and anal fins 8; scales 5-33-3; breast naked: western Pennsylvania and Michigan to western Florida and Kansas; locally very common.

**25. Phenacobius** Cope. Sucker-mouths. Body elongate; teeth 4-4; hooked; mouth small, ventral, each side of the lower lip enlarged into a fleshy lobe; rays of dorsal fin 8; anal 7; isthmus very broad; size small: 4 species, which look like young suckers.

**Key to the Species of Phenacobius**

$a_1$ Breast scaly ..... *P. teretulus.*
$a_2$ Breast scaleless.
  $b_1$ Scales in lateral line 48 to 52 ..... *P. mirabilis.*
  $b_2$ Scales in lateral line 60; eyes large, placed high.
    $c_1$ Scales in front of dorsal fin 24 ..... *P. uranops.*
    $c_2$ Scales in front of dorsal fin 22 ..... *P. catostomus.*

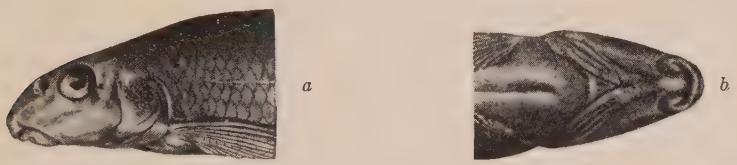



FIG. 37.—Head of *Phenacobius mirabilis: a*, side view; *b*, ventral view (*from Fishes of Illinois*).

*P. teretulus* Cope. Length 85 mm.; head 4.6; depth 4.5; color pale yellowish, the scales above dark-edged; snout blackish; a plumbeous lateral band; scales 6-43-5: Kanawha River, West Virginia; not common.

*P. mirabilis* (Girard). (Fig. 37). Length 85 mm.; head 4.3; depth 4.6; color olivaceous, with a silvery lateral band and a conspicuous black spot at the base of the tail fin; scales 6-43 to 51-5: Illinois River to Arkansas; basin of the Tennessee River; rather common in sandy streams.

*P. uranops* Cope. Length 100 mm.; head 4.75; depth 6; color pale olivaceous, with a dark spot at the base of the tail fin; scales 7-60-6: upper Tennessee basin; common in the river channels.

*P. catostomus* Jordan. Length 100 mm.; head 4.5; depth 5.6; color olivaceous, with a silvery lateral band, dark at the base of the tail fin; scales 7-60-5: Alabama River basin; common.

**26. Rhinichthys** Agassiz. Body elongate; head long and slender; a minute barbel on the maxillary; teeth mostly 2, 4-4, 1 or 2, hooked;

scales small; dorsal fin behind the ventrals; coloration dark; males rosy in the spring: 3 species, 1 in Mexico.

**Keys to the United States Species of Rhinichthys**

$a_1$ Snout projecting far beyond the mouth.....*R. cataractæ.*
$a_2$ Snout projecting but little beyond the mouth.....*R. atronasus.*

*R. cataractæ* (Cuvier & Valenciennes). Long nosed dace. Length 125 mm.; head 4; depth 5 to 5.5; color dark olive, paler below; back almost black; a dark spot on the opercle; body elongate; head long; mouth inferior; rays of dorsal fin 8; anal 7; scales 65: New England to the Columbia; southward to North Carolina and the Great Salt Lake basin; in swift streams; common and variable.

*Subspecies of R. cataractæ*

*R. c. cataractæ* (C. & V.). New England to Wisconsin.

*R. c. dulcis* (Girard). Scales 11 or 12-63 to 70-9 to 12; a dark lateral band: Rocky Mountain region.

*R. atronasus* (Mitchill). Black nosed dace. Length 75 mm.; head 4; depth 4.5; color blackish, with a black lateral band; males in spring with the lateral band, lower fins and sometimes the whole body crimson, the lateral band in late summer becoming orange and later getting dark; rays of dorsal fin 7; anal 7; scales 64; teeth 2, 4-4, 2: New England to Minnesota; southward to Alabama; very common in clear brooks; very variable.

*Subspecies of R. atronasus*

*R. a. croceus* (Storer). Rays of anal fin 6; scales 70; lateral band faint brownish: Tennessee basin; common.

*R. a. lunatus* Cope. Similar to *R. a. croceus;* lateral band obsolete; scales 62: Michigan and Indiana; common.

**27. Agosia** Girard. Similar to *Rhinichthys* except that the premaxillaries are protractile; rays of dorsal fin mostly 8; anal 7: 10 species, all in the Rocky Mountain region.

**Key to the Species of Agosia**

$a_1$ Teeth 1, 4-4, 1.
  $b_1$ Dorsal fin with 8 rays.
    $c_1$ Scales small, more than 70 in the lateral line.
      $d_1$ Scales about 89.....*A. oscula.*
      $d_2$ Scales about 78.....*A. yarrowi.*

$d_3$ Scales about 74 ..... *A. couesi.*
$c_2$ Scales less than 70 in the lateral line ..... *A. adobe.*
*A. nevadensis.*
*A. nubila.*
$b_2$ Dorsal fin with 10 or 11 rays, the anterior one spinelike.
$c_1$ Scales 63 to 70 ..... *A. umatilla.*
$c_2$ Scales 52 to 57 ..... *A. falcata.*
$a_2$ Teeth 4-4 ..... *A. chrysogaster.*

*A. oscula* (Gir.). Length 60 mm.; head 4; depth 4.75; color dusky olive; a scarlet patch above the gill opening and one on the side of the muzzle; scales 18-89-15: lower Colorado and Gila Rivers; not rare.

*A. yarrowi* Jordan & Evermann. Length 125 mm.; head 4.1; depth 5 to 5.5; color dark olive, with 2 ill-defined dark lateral bands; scales 16-78-13: Colorado River basin; very common.

*A. couesi* (Yarrow). Length 110 mm.; head 4; depth 4.25; color dark gray; scales 12-74-11: Colorado River basin.

*A. adobe* J. & E. Length 100 mm.; head 3.6; depth 4.5; clay colored, with a dark lateral band; scales 12-63 to 70-10: Sevier River, Utah; locally abundant.

*A. nevadensis* (Gilbert). Head 3.5; depth 4; color brown, much speckled above, and with a dark lateral stripe; scales 65: warm springs in the deserts of southwestern Nevada.

*A. nubila* (Gir.). Length 85 mm.; head 3.75 to 4.6; depth 3.75 to 5; color dark gray, with a faint lateral band; scales 47 to 70, usually 52 to 65: coastwise streams of Washington, Oregon and basin of the Columbia to Idaho; Yellowstone Park; southeastern Oregon.

*A. umatilla* Gilbert & Evermann. Color dark, mottled; anterior ray of median fins spine-like; scales 13 or 14-63 to 70-7 or 8: Payette and Umatilla Rivers, Idaho.

*A. falcata* Eigenmann & Eigenmann. Color dark, mottled; fins falcate; ventral fins with inner rays united with the body; scales 52 to 57: Columbia River basin; locally abundant.

*A. chrysogaster* Gir. Color dark iron gray, with a darker lateral band; scales 88; teeth 4-4; males with a yellowish belly: Gila River basin.

**28. Hybopsis** Agassiz. Horny-heads. Body elongate or robust; a barbel present on each maxillary; sometimes a second barbel also present; teeth 4-4 or 1, 4-4, 1 or 0, hooked; scales rather large, 35 to 58 in the lateral line; rays of both dorsal and anal fins usually 8: 18 species, mostly in the southern and western States.

### Key to the Species of Hybopsis

$a_1$ Species of very small size—under 100 mm. long.
  $b_1$ Teeth 1-rowed, being 4-4.
    $c_1$ Barbels 4.....*H. tertranemus.*
    $c_2$ Barbels 2.
      $d_1$ Lateral area without a series of dark spots; snout projecting.
        $e_1$ Scales 35 to 44.
          $f_1$ Back speckled with black spots.
            $g_1$ Lower lobe of tail fin pale in color.
              $h_1$ From the Arkansas to the Rio Grande.*H. æstivalis.*
              $h_2$ In the north-central and southeastern States.....*H. hyostomus.*
            $g_2$ Lower lobe of tail fin black.....*H. geldius.*
          $f_2$ Back not speckled.
            $g_1$ Lower lobe of tail fin black.....*H. meeki.*
            $g_2$ Lower lobe of tail fin pale.....*H. montanus.*
        $e_2$ Scales 56.....*H. monacus.*
      $d_2$ Lateral area with a series of round dark spots connected by a lateral band.
        $e_1$ Scales about 44.....*H. dissimilis.*
        $e_2$ Scales about 50.....*H. watauga.*
  $b_2$ Teeth 2-rowed, being 1,4-4, 1 or 0.
    $c_1$ Large dark spot on hinder rays of dorsal fin.....*H. labrosus.*
    $c_2$ No such spot present.
      $d_1$ In South Carolina.....*H. hypsinotus.*
      $d_2$ In Georgia.....*H. rubrifrons.*
      $d_3$ In the central States.....*H. amblops.*
$a_2$ Species of larger size—over 200 mm. long.
  $b_1$ No red on body.....*H storerianus.*
  $b_2$ Fins pale orange.....*H. kentuckiensis.*

*H. tetranemus* Gilbert. Length 50 mm.; head 4; depth 5.3; color silvery, spotted with black; lateral line with 36 to 38 scales; 2 long barbels on each side; head very slender; dorsal fin over the ventrals: basin of the Arkansas; not rare.

*H. æstivalis* (Girard). Length 60 mm.; head 3.75; depth 5.3; color silvery, spotted with black; scales 6-36-4; head very slender; snout projecting beyond the mouth: Arkansas River to the Rio Grande; common in sandy river channels; not in small brooks.

*H. hyostomus* (Gilb.). Length 60 mm.; head 4; depth 5.5; color silvery speckled with black; scales 37; snout long, acute, projecting beyond the mouth half its length: Indiana to Iowa; southward to the Alabama River; northward to Minnesota; common in sandy river channels.

*H. geldius* (Gir.). Length 50 mm.; head 4; depth 5; color silvery, speckled with black above; scales 6-44-4; snout very long, projecting in front of the mouth; rays of anal fin 9; caudal peduncle very long and slender; tail deeply forked: eastern Nebraska to Wyoming and Montana; locally common.

*H. meeki* Jordan & Evermann. Length 50 mm.; head 4; depth 5.5; color silvery, with a dusky lateral streak; lower lobe of tail fin abruptly black; scales 44: Missouri River at St. Joseph.

*H. montanus* Meek. Length 60 mm.; head 3.6; depth 5; color plain brownish, without black dots; rays of anal fin 6; scales 4-37-4: upper Missouri.

*H. monacus* (Cope). Length 100 mm.; head 4; depth 5.25; color light olive; upper hinder part of dorsal fin black; conspicuous black spot at base of tail; scales 8-56-4: Tennessee River basin; scarce.

*H. dissimilis* (Kirtland). Length 100 mm.; head 4.5; depth 5; color olivaceous, mottled; sides with a bluish lateral band, in which is a series of dusky spots; eyes very large; scales 6-40 to 47-5; body long and slender: Lake Erie to the head waters of the Tennessee; common in the river channels.

*H. watauga* J. & E. Similar to *H. dissimilis;* scales 5-48 to 52-4: Virginia to Arkansas; northward to Indiana.

*H. labrosus* (Cope). Length 75 mm.; head 4.25; depth 4.2; color in males dark steel blue with black markings, in females silvery with a blue lateral streak; a large dark spot on the hinder rays of the dorsal fin; a small spot at the base of the tail fin; scales 5-34 to 40-3: basin of the Santee; common.

*H. hypsinotus* (Cope). Length 75 mm.; head 3.75 depth 4; color silvery, with a double series of black specks along the lateral line and a black lateral band; males with red fins; scales 5-40-3: Santee basin; rare.

*H. rubrifrons* (Jordan). Length 75 mm.; head 4; depth 5; color olivaceous, with a plumbeous silvery lateral band; snout in males red with numerous dust-like tubercles and in the spring with red fins; scales 5-36-3: basin of the Altamaha, Georgia; common.

*H. amblops* (Rafinesque). Silver chub. Length 75 mm.; head 4; depth 5; color greenish, with a silvery lateral band which overlays dark pigment scales 5-38-4; rays of anal fin 7: New York to Iowa; southward to Alabama; very common in the Ohio Valley.

*H. storerianus* (Kirtland). Length 250 mm.; head 4.3; depth 4; color greenish, sides silvery; no red present; scales 6-40-4; body compressed, the back elevated; eyes very large: Lake Erie to eastern

Wyoming; southward to Tennessee and Arkansas; common in larger streams.

*H. kentuckiensis* (Raf.). Horny-head; river chub; jerker (Fig. 38). Length 250 mm.; head 4; depth 4.25; color bluish olive; sides with greenish reflection; fins pale orange; a dusky bar behind the opercle; males in the spring with a crimson spot on the side of the head; scales 6-41-5; adults with a swollen crest on the head: Pennsylvania to Wyoming; southward to Alabama; very common in larger streams.

**29. Couesius** Jordan. Body elongate; mouth terminal; a barbel on each maxillary; teeth 2, 4-4, 2, hooked; scales small; rays of both dorsal and anal fins 8: 4 species in the United States, 1 in Mexico.

FIG. 38.—*Hybopsis kentuckiensis* (*from Fishes of Illinois*).

*C. plumbeus* (Agassiz). Length 150 mm.; head 4.5; depth 4.5; color dusky; sides silvery, with a dark lateral band; free margin of the dorsal fin concave; scales 11-60 to 70-7: Lake Superior to northern New York and New Brunswick; very common northwards.

*C. dissimilis* (Girard). Like *C. plumbeus*, but more robust; free margin of dorsal fin nearly straight: upper Missouri and Black Hills region.

*C. greeni* Jord. Length 150 mm.; head 4; depth 4; color dark olive; sides reddish silvery; a dark streak under the eye; scales 10-57-7; body robust; back convex: head waters of the Fraser River; Idaho.

**30. Platygobio** Gill. Body elongate, somewhat compressed; teeth 2, 4-4, 2; head broad and flat; a barbel on each maxillary; rays of both dorsal and anal fins 8; scales large: 2 species.

*P. physignathus* (Cope). Length 150 mm.; head and depth 4.6; color olivaceous, with a plumbeous lateral band; belly white; scales 6-48-5, 20 before the dorsal fin; body slender: upper waters of the Arkansas; very common in the river channels.

*P. gracilis* (Richardson). Flatheaded chub. Length 300 mm.; head 4.25; depth 4.75; color pale olive; head white; scales 6-50-5, 23 before the dorsal fin: head waters of the Missouri and Yellowstone to

the Saskatchewan; eastward to Kansas City; common in river channels.

**31. Exoglossum** Rafinesque. Body moderately elongate; the two sides of the lower jaw united its whole length, instead of forming a broad arch, and looking like a projecting tongue; teeth 1, 4-4, 1: 1 species.

*E. maxillingua* (LeSueur). Cut-lip; nigger chub. Length 150 mm.; head 4; depth 4.5; color olivaceous; a black bar behind the opercle; rays of dorsal fin 8; anal 7; scales 8-53-5: St. Lawrence River and Lake Ontario to Virginia; locally abundant.

**Order 4. Heterognathi.**—The four anterior vertebræ modified and coössified, and Weberian ossicles present; fins soft-rayed; lower pharyngeals not falciform; ventral fins abdominal; no pseudobranchiæ: 2 families of tropical fishes, represented by a single species in Texas.

**Family Characinidæ.**—Adipose fin present; head naked; scales cycloid: 300 species.

**Tetragonopterus** Cuvier. Body oblong, compressed; lateral line complete; premaxillary teeth in a double row: 40 species.

*T. argentatus* (Baird & Girard). Head 4; depth 3; color olivaceous, with a lateral silvery band and a black caudal spot; rays of dorsal fin 10; anal 21; scales 6-38-6: southern Texas and Mexico; abundant.

**Order 5. Nematognathi.**—Catfish. The four anterior vertebræ modified and with Weberian ossicles; no subopercle; ventral fins abdominal; fins soft rayed, except the dorsal and pectoral fins, each of which has a single spine; scales wanting, the skin being naked or with bony plates; the border of the mouth formed by the premaxillaries, the maxillary being often rudimentary; barbels present on the maxillaries: several families, 1 in America.

**Family Siluridæ.**—Body elongate; upper jaw formed of premaxillaries alone; maxillaries rudimentary; 2 or more barbels on anterior part of head; adipose fin present; a stout spine forms the anterior ray of dorsal and pectoral fins; lower pharyngeals separate; air bladder large: over 900 species and 100 genera, most of which are fresh water fish living in the warmer regions of Africa and South America, especially the Amazon region; a few species marine, mostly in tropical waters; about 30 species in the United States, none of which are on the Pacific slope except a few which have been introduced.

### Key to the Genera of Siluridæ in the United States

$a_1$ Posterior margin of adipose fin not adnate to back.

$b_1$ Rays of anal fin 17 to 35.

$c_1$ Complete bony ridge extending from the head to the dorsal fin.....1. *Ictalurus.*
$c_2$ Bony ridge from head to dorsal fin interrupted.....2. *Ameiurus.*
$b_2$ Rays of anal fin 12 to 15.....3. *Leptops.*
$a_2$ Posterior margin of anal fin adnate to back.
$b_1$ Adipose fin separated from caudal fin by a distinct notch....4. *Noturus.*
$b_2$ Adipose fin either not separated from the caudal fin or separated only by a slight notch.....5. *Schilbeodes.*

**1. Ictalurus** Rafinesque. Channel cats. Body slender; head conical; mouth small; supraoccipital process prolonged posteriorly, its emarginate end receiving the anterior tip of the second interspinal, thus forming a continuous bony ridge between the head and the dorsal fin; rays of dorsal fin usually I, 6; caudal fin deeply forked; 8 barbels present: 4 species, 1 in Gautemala, all important food fishes.

**Key to the United States Species of Ictalurus**

$a_1$ Body not spotted.
$b_1$ Anal fin with 32 to 35 rays.....*I. furcatus.*
$b_2$ Anal fin with 24 to 26 rays.....*I. anguilla.*
$a_2$ Body spotted.....*I. punctatus.*

*I. furcatus* (LeSueur). Great forked-tail cat (Fig. 39). Extreme length 1,500 mm.; extreme weight 150 lbs.; average weight 10 lbs.; head 4.5; depth 4; color silvery; anal fin almost one third the length of the body: Mississippi Valley and Gulf States; northward to Iowa and Ohio; abundant in the south.

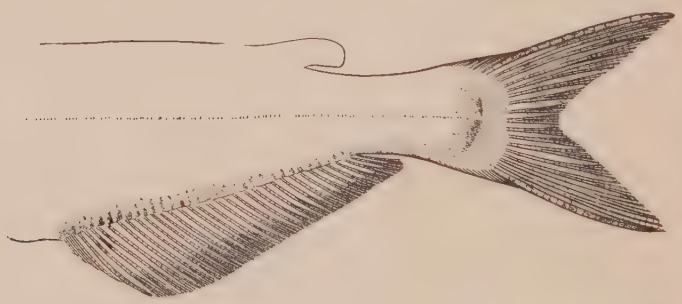


FIG. 39.—Anal and caudal fins of *Ictalurus furcatus* (*from Fishes of Illinois*).

*I. punctatus* (Raf.). Channel cat; spotted cat (Fig. 40). Extreme length 600 mm.; extreme weight 25 lbs.; head 4; depth 5; color olivaceous, with small irregular round black spots; anal fin with 25 to 29 rays: Great Lakes, Gulf slope and Mississippi Valley regions; generally abundant in the channels of large streams.

*I. anguilla* Evermann & Kendall. Eel cat. Length 450 mm.; color pale bluish or yellowish: Mississippi Valley from the Ohio to Louisiana.

**2. Ameiurus** Rafinesque. Small catfish and bullheads. Body rather stout; head broad; mouth large; rays of dorsal fin about I, 6; anal

FIG. 40.—Anal and caudal fins of *Ictalurus punctatus* (*from Fishes of Illinois*).

15 to 35; tail usually convex or truncate; barbels 8: premaxillary teeth a transverse band (Fig. 41): numerous species, all in America except *A. cantonensis.* in China.

FIG. 41.—Premaxillary teeth of: *a, Ameiurus melas; b, Noturus flavus; c, Leptops olivaris,* and *d, Schilbeodes gyrinus* (*from Fishes of Illinois*).

### Key to the American Species of Ameiurus

$a_1$ Caudal fin forked.
  $b_1$ In the Great Lakes and northwards.....*A. lacustris.*
  $b_2$ From the Delaware River to Texas.....*A. catus.*
$a_2$ Caudal fin truncated or convex.
  $b_1$ Eyes well developed.
    $c_1$ Anal fin with 24 to 27 rays.....*A. natalis.*
    $c_2$ Anal fin with 15 to 22 rays.
      $d_1$ Lower jaw projecting.....*A. vulgaris.*
      $d_2$ Lower jaw not projecting.
        $e_1$ Body robust.

$f_1$ Anal fin with 21 or 22 rays.....*A. nebulosus.*
$f_2$ Anal fin with 17 to 19 rays.....*A. melas.*
$e_2$ Body slender; in the south Atlantic States.
$f_1$ Anal fin with 22 to 24 rays.....*A. erebennus.*
$f_2$ Anal fin with 16 to 20 rays.....*A. platycephalus.*
$b_2$ Eyes concealed; a cave species.....*A. nigrilabris.*

*A. erebennus* Jordan. Body elongate; length 300 mm.; head and depth 4; color black above, pale below; fins and barbels black; tail truncated: coastwise waters from New Jersey to Florida; rare.

*A. lacustris* (Walbaum). Great Lakes catfish. Length up to 1,500 mm.; average weight 8 lbs.; extreme weight 40 lbs.; head 4; depth 5; color slaty; sides paler; no spots; rays of dorsal fin I, 5; anal 25 to 32; caudal fin deeply forked: Great Lakes basin and large lakes and rivers northwards.

*A. catus* (L.). (*A. albidus* LeSueur). White cat. Length 600 mm.; head 3.8; color pale bluish, without spots, but sometimes mottled; anal fin with 19 rays; caudal fin deeply forked; head very broad and mouth very large: eastern States from New York to Texas; introduced into California; very common in coastwise streams and swamps.

*A. natalis* (LeSueur). Yellow cat. Length 450 mm.; head 3.5; color yellowish, clouded with darker; caudal fin truncated; body stout; mouth wide: from Great Lakes region southwards into Alabama and Texas; very common.

*A. vulgaris* (Thompson). Common catfish. Length 450 mm.; head 3.5 to 4; depth 4.5 to 5; color dark brown or blackish; anal fin with 20 rays; lower jaw more or less projecting: Vermont to Minnesota, and northwards; southward to western New York and Illinois.

*A. nebulosus* (LeSueur). Common bullhead; horned pout. Length up to 450 mm.; head 3.8; depth 4 to 4.5; color dark yellowish brown, mottled with darker; anal fin with 21 or 22 rays and extending about a quarter the length of the body; upper jaw longer than the lower: Maine to North Dakota; southward to Florida and Texas; introduced into California; very common.

*Subspecies of A. nebulosus*

*A. n. catulus* (Girard). Color nearly black: Texas; common.

*A. n. marmoratus* (Holbrook). Color strongly marked: Indiana to Florida.

*A. melas* (Raf.). Black bullhead. Length 250 mm.; head 375; depth 3.5 to 4.5; color blackish; body stout; anal fin very deep, with 17 to 19 white rays: northern New York to Nebraska; southward

to Kentucky and Texas; common, especially westward of the Mississippi.

*A. platycephalus* (Gir.). Brown cat. Length 450 mm.; head 3.5; depth 5.5; to 8; color olive brown; body very slender; head flat and broad; upper jaw projecting; anal fin with 16 to 20 rays: Carolina and Georgia; common.

*A. nigrilabris* (Cope). Length 250 mm.; color black above; anal fin with 18 rays; eyes rudimentary, beneath the skin; barbels short: in cave streams tributary to the Conestoga River in eastern Pennsylvania.

**3. Leptops** Rafinesque. Body large, elongate; head very wide and flat; mouth very large, with a projecting lower jaw; skin thick and villose; premaxillary teeth form a broad villiform band, convex anteriorly, with a backward prolongation on each side (Fig. 41); anal fin slightly concave: 1 species.

*L. olivaris* (Raf.). Mud cat; goujon. Extreme length 1,500 mm.; extreme weight 100 lbs.; average weight 35 lbs.; color yellowish, mottled with brown or greenish; body slender; anal fin with 12 to 15 rays; dorsal spine short: Mississippi Valley and Gulf States; common in deep, sluggish waters.

**4. Noturus** Rafinesque. Body elongate and similar to *Leptops;* dentition also similar (Fig. 41); adipose fin long, low and keel-like and adnate posteriorly and separated from the tail by a notch; a poison gland at the base of the pectoral spine; skin tough and villose: 1 species.

*N. flavus* Raf. Stone cat. Length 300 mm.; head 4.25; depth 5.6; color yellowish brown; dorsal spine very short; anal fin with about 16 rays; barbels short: Great Lakes region and westward into Montana; southward to Texas; often common in small sluggish streams.

**5. Schilbeodes** Bleeker. Mad-toms. Body small, elongate; head flattened; mouth large, with a somewhat projecting upper jaw; teeth in a broad convex band in each jaw (Fig. 41); adipose fin as in *Noturus;* anal fin with 12 to 23 rays; a poison gland as in *Noturus:* several species, some very rare, in southern and western States, in small rocky streams.

**Key to the Species of Schilbeodes**

$a_1$ Pectoral spine not serrate behind.
  $b_1$ In the Great Lakes region and Mississippi Valley. . . . . *S. gyrinus.*
  $b_2$ In the Gulf States. . . . . *S. leptacanthus.*
$a_2$ Pectoral spine more or less distinctly serrate behind.
  $b_1$ Adipose fin continuous with the tail, no notch present. . . . . *S. nocturnus.*

$b_2$ Adipose fin separated from the tail by a notch.
  $c_1$ Posterior serræ of pectoral spine not half the diameter of the spine.
    $d_1$ From Wisconsin to Kansas..... *S. exilis.*
    $d_2$ From Pennsylvania to South Carolina..... *S. insignis.*
    $d_3$ In the Roanoke River..... *S. gilberti.*
  $c_2$ Posterior serræ of pectoral spine almost as long as the diameter of the spine.
    $d_1$ Color plain..... *S. eleutherus.*
    $d_2$ Color blotched..... *S. miurus.*
*S. furiosus.*

*S. gyrinus* (Mitchill). Mad-tom (Fig. 42). Length 125 mm.; head 3.5 to 4; depth 4 to 5.5; color uniform yellowish brown, with a narrow

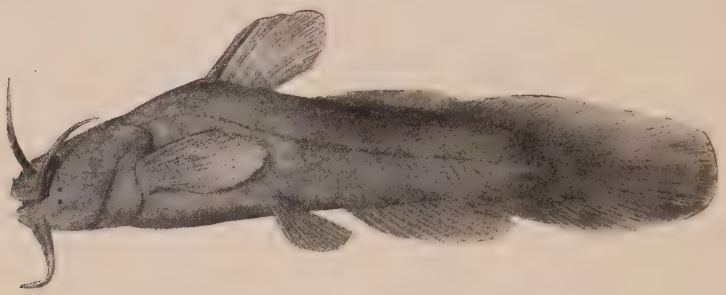


FIG. 42.—*Schilbeodes gyrinus (from Fishes of Illinois).*

lateral black streak; pectoral spine smooth; adipose fin continuous with the tail fin; anal fin with 13 to 15 rays: Hudson River and westward throughout the Great Lakes region and Mississippi Valley; common towards the north.

*S. exilis* (Nelson). Length 100 mm.; head 4; depth 5 to 6.5; color yellowish, mottled; anal fin with 14 to 17 rays: Wisconsin to Kansas; common.

*S. insignis* (Nel.). Mad-tom. Length 250 mm.; head 4.25; depth 6; color dark brown, somewhat mottled; fins dark edged; anal fin with 14 to 16 rays; upper jaw projecting: New York to South Carolina; very common in coastal streams.

*S. miurus* (Jordan). Length 100 mm.; head 4; depth 5; color mottled black and gray, with 4 black blotches; top of head, tip of dorsal, middle of adipose and edge of caudal fins black; adipose fin with a deep notch, but connected with the tail fin; anal fin with 13 to 15 rays: Mississippi Valley and tributaries of Lakes Ontario and Michigan; common.

*S. furiosus* Jordan & Meek. Like *S. miurus*, but with long spines: eastern North Carolina.

*S. leptacanthus* (Jordan). Length 75 mm.; body slender; color yellowish, mottled; spines short; rays of anal fin 14: Gulf States, in sandy streams; rare.

*S. gilberti* (Jordan & Evermann). Length 100 mm.; body slender; color yellowish; base of tail fin and most of its lower lobe black; rays of anal fin 15; dorsal fin black at base: Roanoke River; common.

*S. eleutherus* (Jordan). Length 100 mm.; head 3.8; color plain brownish, with faint saddle-like blotches on the back; rays of anal fin 13: Mississippi Valley; often common.

*S. nocturnus* (Jordan & Gilbert). Length 75 mm.; head 3.6; color dark brown, dotted with black; rays of anal fin 15 or 16: Mississippi Valley from Indiana to Arkansas.

**Order 6. Haplomi.**—Pike and pickerel. Soft rayed fish with anterior vertebræ distinct and without Weberian ossicles; no adipose fin; pseudobranchiæ wanting or glandular; body covered with cycloid scales; ventral fins abdominal; head usually more or less scaly; air bladder with pneumatic duct: 4 families of mainly fresh water fishes.

**Key to the Families of Haplomi**

$a_1$ Lateral margin of upper jaw formed by the maxillaries.
  $b_1$ No lateral line present; fishes of small size.....1. *Umbridæ.*
  $b_2$ Lateral line present; fishes of large size.....2. *Esocidæ.*
$a_2$ Lateral margin of upper jaw formed by the premaxillaries; small fishes.
  $b_1$ Anus normal in position.....3. *Pœciliidæ.*
  $b_2$ Anus close to the gills.....4. *Amblyopsidæ.*

**Family 1. Umbridæ.**—Mud minnows. Body elliptical, broad anteriorly, compressed posteriorly; teeth well developed and on the premaxillaries, mandibles, vomer and palatines; maxillaries toothless; no lateral line; no pyloric cæca; dorsal fin more or less posterior in position; scales large; branchiostegals 6 or 8; tail fin rounded: 1 genus and 3 species of small fishes living near the bottom of ponds and sluggish streams.

**Umbra** Muller. With the characters of the family: 3 species, 2 in the United States.

*U. limi* (Kirtland). Length 100 mm.; head 3.75; depth 4.25; color olive green, with 14 narrow irregular pale transverse dark bars; rays of dorsal fin 14; anal 8; scales 35: Quebec to Minnesota and southward to the Ohio river; common in the basin of the Great Lakes.

*U. pigmæa* (Dekay) (Fig. 43). Length 100 mm.; head 4; depth 4.5; color dark greenish, with about 12 narrow longitudinal pale stripes and a

dark transverse bar at the base of the tail fin; rays of the dorsal fin 13; anal 7; scales 35: coastwise streams and swamps from Long Island to the Neuse River; locally common.

**Family 2. Esocidæ.**—Body elongate, slender, compressed posteriorly; head long and flat; mouth very large, with a projecting lower jaw; maxillaries with a supplementary bone; teeth strong and on the premaxillaries, vomer, palatines, mandibles and tongue; head naked above and more or less scaled on the sides; scales small; lateral line weak, wanting in the young; tail forked; dorsal fin opposite the anal and near the

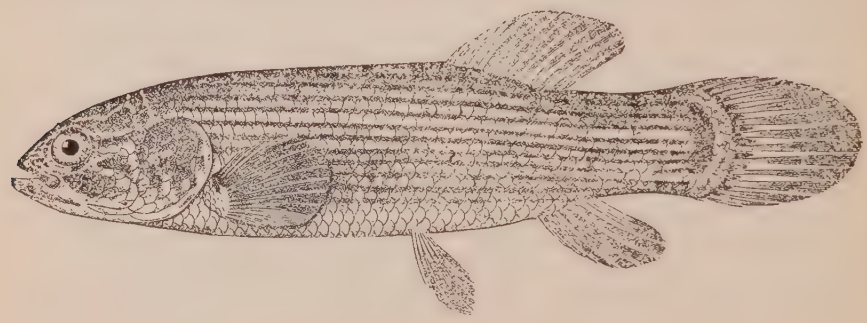


FIG. 43.—*Umbra pygmæa (from Jordan & Evermann).*

tail; branchiostegals 12 to 20; no pyloric cæca: 1 genus; fresh water fish of moderate or large size noted for their fierceness and voracity.

**Esox** L. Pike: pickerel. With the characters of the family: 5 species; all important food and game fishes.

**Key to the Species of Esox**

$a_1$ Opercle not scaly on the lower half.
  $b_1$ Cheeks entirely scaly.....*E. lucius.*
  $b_2$ Cheeks not scaly on the lower half.....*E. masquinongy.*
$a_2$ Opercle and cheek entirely scaly.
  $b_1$ Rays of dorsal fin 14.....*E. reticulatus.*
  $b_2$ Rays of dorsal fin 11 or 12.
    $c_1$ In the Mississippi Valley and Great Lakes basin.....*E. vermiculatus.*
    $c_2$ In Atlantic coastwise streams.....*E. americanus.*

*E. lucius L.* Common Pike (Fig. 44). Length up to 1,200 mm.; weight up to 40 lbs.; head 3.4; depth 5; color bluish or greenish gray, with many irregular whitish or yellowish spots arranged in more or less longitudinal lines; median fins with irregular black spots; rays of dorsal fin 16 or 17; anal 13 or 14; scales 123; branchiostegals 14 to 16: northern America, Europe and Asia; southward to New York and the Ohio River; northward to Alaska; very common.

*E. masquinongy* Mitchill. Muscalonge; muskallunge. Length 900 mm.; extreme length 2,500 mm.; extreme weight 100 lbs.; head 3.6; depth 6; color dark gray; sides with numerous black spots; lower portion of cheek and opercle without scales; rays of dorsal fin 17; anal 15; scales 150; branchiostegals 17 to 19: Great Lakes region and upper Mississippi Valley, and northwards; not common; occasionally in the Ohio Valley as far south as North Carolina.

*Subspecies of E. masquinongy*

*E. m. ohiensis* (Kirtland). Sides with narrow dark cross bars which split up into diffuse spots: Ohio River basin; Lake Chautauqua.

*E. m. immaculatus* Jordan & Evermann. Body unspotted: Wisconsin; common.

*E. reticulatus* LeSueur. Common pickerel; chain pickerel. Length 600 mm.; head 3.5; depth 6; color green; sides marked with numerous

FIG. 44.—*Esox lucius* (*from Jordan & Evermann*).

irregular dark lines forming a network; a dark band below the eye; fins plain; rays of dorsal fin 14; anal 13; scales 125; branchiostegals 14 to 16: Atlantic and Gulf slope, Maine to Florida and Louisiana; Arkansas; very numerous in the New York lakes and east and south of the Alleghenies.

*E. vermiculatus* LeSueur. Grass pike; little pickerel. Length 300 mm.; head 3.25; depth 5 to 6; color green or grayish, sometimes plain but usually with an irregular network of dark streaks on the sides; a dark bar downward from the eye; rays of dorsal and anal fins 11 or 12; body rather stout; scales 105; branchiostegals 11 to 13: Mississippi Valley and the southern tributaries of Lakes Michigan, Erie and Ontario; common.

*E. americanus* Gmelin. Banded pickerel. Length 300 mm.; head 3.6; depth 5.5; color dark green; sides with about 20 blackish curved bars; rays of dorsal and anal fins 11 or 12; scales 105; opercle fully scaled: coastwise streams and ponds from Maine to Florida; common.

**Family 3. Pœciliidæ.**—Killifish. Small fish with moderately elongate body, flattened head and rather large cycloid scales; head more or less scaly; mouth small, terminal, with a projecting lower jaw; upper jaw very protractile, its margin formed by the premaxillaries; branchiostegals 4 to 6; tail not forked; no pyloric cæca; no lateral line; many species ovoviviparous: about 30 genera and 180 species, occurring in fresh and brackish water in all the warmer waters of Europe, Asia, Africa and America; about 30 fresh water species in the United States, largely in coastwise inlets and swamps of the southern States.

**Key to the Fresh Water Genera of Pœciliidæ in the United States**

$a_1$ Lower jaw usually projecting beyond the upper; teeth little movable; species mostly carnivorous.
  $b_1$ Anal fin of male of normal shape; species oviparous.
    $c_1$ Teeth pointed, not compressed, and neither bicuspid nor tricuspid.
      $d_1$ Teeth in more than one series.....1. *Fundulus.*
      $d_2$ Teeth in a single series; dorsal fin in front of the anal.....2. *Lucania.*
    $c_2$ Teeth not pointed but notched and tricuspid.
      $d_1$ Dorsal fin with 10 to 12 rays.....3. *Cyprinodon.*
      $d_2$ Dorsal fin with 15 to 18 rays.....4. *Jordanella.*
  $b_2$ Anal fin of male a long sword-shaped organ; species viviparous.....5. *Gambusia.*
$a_2$ Lower jaw short; teeth movable; species mostly mud-eating.
  $b_1$ Teeth in a single series.....6. *Heterandria.*
  $b_2$ Teeth in more than one series.....7. *Mollienisia.*

**1. Fundulus** Lacépède. Killifish. Body rather elongate, sometimes chubby; compressed behind; eyes large; teeth in 2 or more series in each jaw, and pointed; air bladder present: many species, mostly American, living in fresh water and arms of the sea; about 20 species in the United States.

**Key to the United States Species of Fundulus**

$a_1$ Dorsal fin with 11 to 17 rays; not top-swimming species.
  $b_1$ Dorsal fin inserted before the front of the anal; branchiostegals 5 or 6.
    $c_1$ Scales 35 in longitudinal series.....*F. heteroclitus.*
    $c_2$ Scales 45 to 60.
      $d_1$ Scales 45.....*F. diaphanus.*
      $d_2$ Scales 60.....*F. zebrinus.*
      $d_3$ Scales 52.....*F. seminolis.*
  $b_2$ Dorsal fin inserted over or slightly behind the front of the anal fin.

$c_1$ Scales 50 to 53.
$d_1$ Orange spots in longitudinal rows on side of body....*F. catenatus.*
$d_2$ Large irregularly placed orange spots on side of body..*F. stellifer.*
$c_2$ Scales 32 to 42.
$d_1$ Rays of anal fin 14.....*F. lineatus.*
$d_2$ Rays of anal fin 9 to 11.
$e_1$ Scales 38.....*F. rathbuni.*
$e_2$ Scales 42.....*F. albolineatus.*
$a_2$ Dorsal fin with 7 to 11 rays; top-swimming species.
$b_1$ Anal fin with 12 or 13 rays.
$c_1$ Scales 35.....*F. macdonaldi.*
$c_2$ Scales 29.....*F. floripinnis.*
$b_2$ Anal fin with 8 to 12 rays.
$c_1$ No distinct black vertical or longitudinal stripes.
$d_1$ Sides with large irregularily placed orange spots.....*F. henshalli.*
$d_2$ Sides with minute orange spots posteriorly.....*F. rubrifrons.*
$d_3$ Coloration plain, without spots.....*F. sciadicus.*
$c_2$ Distinct black vertical stripes present; no longitudinal stripes.
$d_1$ Rays of dorsal fin 9; anal 11.....*F. chrysotus.*
$d_2$ Rays of dorsal fin 7; anal 8.....*F. cingulatus.*
$c_3$ Distinct black longitudinal stripes, often with vertical ones.
$d_1$ Many longitudinal stripes present.
$e_1$ Six black stripes present.....*F. notti.*
$e_2$ Stripes formed of series of disconnected dots.....*F. guttatus.*
$e_3$ Ten wavy longitudinal lines present.....*F. dispar.*
$d_2$ A single wide black stripe present.....*F. notatus.*

*F. heteroclitus* (L.). Common killifish; mummichog. Length 75 to 150 mm.; head 3.5; depth 3.6; color of male greenish, sometimes orange

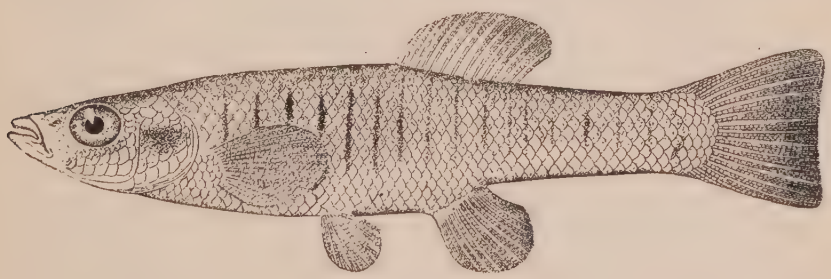


FIG. 45.—*Fundulus diaphanus* (*from Jordan & Evermann*).

below; sides with many narrow, silvery bars made up of spots, besides many scattered spots; median fins dark with pale spots; females plain; dorsal fin 11; anal 10 or 11; scales 35 to 38-13: Maine to Mexico; very common in shallow water along the sea shore and in the mouths of streams.

*F. diaphanus* (LeSueur) (Fig. 45). Length 100 mm.; head 4; depth 4.8; color olivaceous; sides silvery, with about 20 dark vertical bars; rays of dorsal fin 13; anal 11; scales 45-15; body rather slender: eastern and central States from Maine to Cape Hatteras; westward to Colorado; common in streams and ponds; also in the mouths of rivers.

*Subspecies of L. diaphanus*

*F. d. menona* Jordan & Copeland. Rays of dorsal fin 12; anal 10; scales 48-12; bars very distinct; back spotted: Ohio River to the Mississippi.

*F. zebrinus* Jordan & Gilbert. Length 75; head 3.5; depth 4.5; color greenish above; sides silvery, tinged with yellow and with 14 to 18 dark vertical bars; rays of dorsal fin 14 to 15; anal 13 or 14; scales 60-21: South Dakota to western Iowa, Texas and New Mexico; common in tributaries of the upper Arkansas.

*F. seminolis* Girard. Head 4.2; depth 6; color olive green; scales with dark edges which form several longitudinal streaks and sometimes faint cross bars; rays of dorsal fin 17; anal 13; scales 52: rivers and swamps of eastern Florida; common.

*F. catenatus* (Storer). Length 150 mm.; head 4; depth 4.5; color bluish or greenish, with an orange spot on each scale forming thus regular lines; rays of dorsal fin 14; anal 15; scales 50: Tennessee and Cumberland Rivers and in the Ozark region, in mountain streams; abundant.

*F. stellifer* (Jordan). Length 100 mm.; head 3.75; depth 5; color blue above, silvery below, with large orange spots irregularily placed; rays of dorsal and anal fins 13; scales 53: Alabama River basin.

*F. lineatus* (Garman). Head 3; depth 4.25; color brownish above dotted with brown; rays of dorsal fin 11; anal 14; scales 36-12: northeastern Wyoming.

*F. rathbuni* Jordan & Meek. Length 65 mm.; head 3.8; depth 4.5; color pale green, with small irregular oblong dark brown spots scattered over head and body; rays of dorsal and anal fins 11; scales 38-12: eastern North Carolina; common; not in salt water.

*F. albolineatus* Gilbert. Length 85 mm.; head 3.3; depth 3.6; color dark brown; sides plumbeous, with whitish streaks in males and narrow black lines in females; rays of dorsal and anal fins 10 or 11; scales 42: Tennessee basin in Alabama.

*F. macdonaldi* (Meek). Length 65 mm.; head 3.6; depth 4.5; color greenish, with no distinct markings; rays of dorsal fin 11; anal 12 to

14; scales 35-12: tributaries of the Neosho and Gasconade Rivers in southern Missouri.

*F. floripinnis* (Cope). Length 65 mm.; head 4.1; depth 5; color olive gray; scales bordered with orange; fins yellow, edge with crimson; rays of dorsal fin 10; anal 13; scales 29-10: Platte and Colorado Rivers in Colorado.

*F. henshalli* (Jordan). Length 100 mm.; head 3.5; depth 4; color olivaceous; sides with large orange spots which extend onto the median fins; rays of dorsal fin 7 or 8; anal 10 or 11; scales 33-10: rivers and swamps of southern Florida.

*F. rubrifrons* (Jord.). Length 75 mm.; head 3.25; depth 3.75; color dark olivaceous, with a dark orange spot on each scale posteriorly; faint narrow orange bars along the lower and hinder part of the body; rays of dorsal fin 7 or 8; anal 8 or 9; scales 32-11 or 12: streams and swamps of eastern Florida.

*F. sciadicus* Cope. Length 65 mm.; head 3.5; depth 4; color uniform olivaceous; rays of dorsal fin 10; anal 12; scales 34-12: eastern Nebraska and South Dakota; common in grassy streams.

*F. chrysotus* Holbrook. Length 50 mm.; head 3.5; depth 3.8; color light olive brown; sides with about 14 indefinite half-bars; rays of dorsal fin 9; anal 11; scales 32 or 33-12: coastwise swamps from South Carolina to Florida and New Orleans.

*F. cingulatus* Cuvier & Valenciennes. Head 3.5; depth 3.75; color olivaceous, with fine dots; scales edged with dusky, forming a few faint longitudinal stripes; about 15 dark vertical bars; fins red; rays of dorsal fin 7; anal 8; scales 34-10: South Carolina to Florida, in coastwise swamps.

*F. notti* (Agassiz). Length 35 mm.; head 3.6; depth 4.5; color silvery, with 6 narrow jet-black lines from head to tail, these being crossed by about 12 cross bars; cheeks orange; rays of dorsal fin 7 or 8; anal 9 or 10; scales 36-10: Florida to South Carolina.

*F. guttatus* (Ag.). Head 3.75; depth 5; color orange brown; each scale with a black edge, these forming longitudinal stripes, but not confluent; cheeks orange; rays of dorsal fin 6 or 7; anal 8 or 9; scales 36-12: Florida to Texas.

*F. dispar* (Ag.). (Fig. 46). Length 65 mm.; head 3.75; depth 3.5; color bluish or greenish in life, with a blue patch under the eye, female with 10 distinct longitudinal brownish lines; males with about 7 longitudinal rows of small brown spots and 9 dark cross bars; rays of dorsal fin 7; anal 9; scales 35-10: northern Ohio to Missouri; southward to Mississippi; common in sluggish streams.

*F. notatus* (Rafinesque). Top minnow. Length 75 mm.; head 4; depth 4.5; color brownish olive, with a broad dark band running from the tip of the snout to the tail; back dotted; rays of dorsal fin 9; anal 11; scales 34-11: Michigan to Alabama and Texas; common.

**2. Lucania** Girard. Body elliptical, compressed; lower jaw projecting and prominent, the mouth being short and oblique; each jaw

*a*

*b*

FIG. 46.—*Fundulus dispar: a*, male; *b*, female (*from Fishes of Illinois*).

with a single series of teeth; scales very large; dorsal fin above or in advance of the anal: 4 species of very small fishes in the coastwise swamps of the southern States.

**Key to the Species of Lucania**

$a_1$ Rays of dorsal fin 6 or 7 ..... *L. ommata.*
$a_2$ Rays of dorsal fin 9 to 12.
  $b_1$ A black lateral band present ..... *L. goodei.*
  $b_2$ No such band.
    $c_1$ Along the Gulf coast ..... *L. venusta.*
    $c_2$ Along the Atlantic coast ..... *L. parva.*

*L. ommata* (Jordan). Length 20 mm.; head 3.3; depth 5; straw-color, the male with 5 or 6 dark bars, the female with a jet-black spot just in front of the anal fin and a larger spot at the upper part of the base of the tail; rays of the dorsal fin 6 or 7; anal 9 or 10; scales 26 to

28-9; body slender; eyes large: swamps of Florida; scarce; one of the smallest known fishes.

*L. goodei* Jord. Length 40 mm.; head 4; depth 4.25; color olivaceous, with a distinct black band running from the snout to the tail where it ends in a round spot; rays of dorsal and anal fins 9; scales 29 to 32-7: Everglades region; common.

*L. venusta* Gir. Length 50 mm.; head 3.5; depth 3.5; color light olive; scales dark edged; dorsal, caudal and pectoral fins yellow in male, plain in female; ventral and anal fins orange; dorsal fin with a black spot at its base and with 11 or 12 rays; anal with 9 or 10; scales 26-8: lagoons and inlets of the Gulf coast from Florida to Mexico; often very common.

*L. parva* Baird & Girard. Rain-water fish. Length 45 mm.; head 3.25; depth 3.25 color; olive; fins in male orange tipped with black; dorsal fin with a large black spot at its base and with 10 to 12 rays; anal with 10 or 11; scales 26-8: Atlantic coast from Connecticut to Key West, near the shore and in brackish pools; very common towards the south.

**3. Cyprinodon** Lacépède. Body short, deep, elliptical, the back elevated; mouth small; teeth tricuspid, in a single series; scales very large; dorsal fin high and in advance of the anal: 9 species, in brackish waters of the southern States and Mexico.

*C. variegatus* Lac. Length 75 mm.; head 3.25; depth 2; color of male olivaceous, blue above; color of anterior portion of the sides and of belly salmon; tail with a black bar at base and tip; female light olive, with about 14 cross streaks; rays of dorsal fin 11; anal 10; scales 26-13: Cape Cod to the Rio Grande, in brackish waters and the mouth of streams; very common.

**4. Jordanella** Goode & Bean. Body short, deep, compressed; back elevated; mouth small; teeth in a single series; dorsal fin long; scales large; tail rounded; viviparous: 1 species.

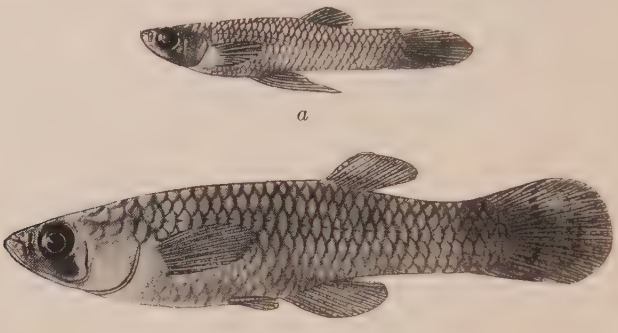
*J. floridæ* G. & B. Length 65 mm.; head 3.5; depth 2 to 2.5; color olivaceous, with a blue stripe along each series of scales, and 4 or 5 vague vertical bars; rays of dorsal fin I, 14 to 16; anal I, 11 to 13; scales 25 to 27-11 or 12: streams and swamps of Florida; common.

**5. Gambusia** Poey. Top minnow. Body elongate; mouth small; scales large, anal fin in male very long and slender and modified to form a long intromittant organ; ventral fins near the pectorals; dorsal fin behind the anal; viviparous: 8 species of small fish in fresh waters of the southern States, Cuba, and Mexico; 1 species in the United States.

*G. affinis* (Baird & Girard) (Fig. 47). Length 50 mm. (female); male much smaller; head 4; depth 4; color light olive, each scale edged

with darker; a very narrow, often indefinite, lateral stripe; rays of dorsal fin 7 to 9; anal 8 to 10; scales 29 to 32-8 to 10: marshes of the Atlantic and Gulf coasts from Delaware to Mexico and northward to Kentucky, Tennessee and southern Illinois in the Mississippi Valley; in brackish and fresh water; very common in the south.

**6. Heterandria** Agassiz. Top minnow. Body rather stout; mouth very small; both jaws with a single series of teeth; scales large; anal fin in advance of the dorsal, and in the male modified to form an intromittant organ; viviparous: 6 species of very small fish in swamps in



*a*

*b*

FIG. 47.—*Gambusia affinis: a*, male; *b*, female (*from Fishes of Illinois*).

the southern States, West Indies and Mexico; 2 species in the United States.

*H. formosa* Ag. Length 20 to 25 mm.; head 3.5; depth 3.75; color brownish olive, with a wide black lateral band crossed by 6 to 9 vertical bars; a black spot on the dorsal and anal fins; rays of dorsal fin 7; anal 6 to 9; scales 24 to 28: South Carolina to Florida; very common in swamps and ditches, often in company with *Gambusia affinis;* one of the smallest of known fishes.

*H. occidentalis* Baird & Girard. Length 65 mm.; head 3.5; depth 4; color brownish, dotted with black, with a black lateral stripe; rays of dorsal fin 7 or 8; anal 9 or 10; scales 29-8: southern Arizona; common in springs and ditches.

**7. Mollienisia** LeSueur. Body rather stout; mouth small; both jaws with a narrow band of small teeth; scales large; anal fin behind the dorsal and modified in the male to form an intromittant organ: 4 species in the southern States and Mexico; 1 species in the United States.

*M. latipinna* LeS. Length 75 mm.; head 3.5 to 4; depth 2.5 to 3; color light green, in the male marbled with darker and spotted, with longitudinal lateral series of blackish spots; dorsal fin very long and in the male very elevated, exceeding the height of the body, translucent

and with a series of spots; tail fin with round spots; rays of dorsal fin 15 to 16; anal 8; scales 26-9 or 10: South Carolina to Mexico, in swamps and streams; very common.

**Family 4. Amblyopsidæ.**—The blind fishes. Body elongate, compressed behind; head long, depressed; mouth large; premaxillaries forming the entire margin of the upper jaw; head naked; tail fin pointed or rounded behind; scales small, cycloid, more or less imbedded so that the body appears naked; no lateral line; anus close behind the gills; fins spineless; ovary single; viviparous: 3 genera and 5 species; in small streams along our southern coast, and also in subterranean streams, these being blind and colorless.

**Key to the Genera of Amblyopsidæ**

$a_1$ Eyes present and functional; ventral fins wanting ..... 1. *Chologaster.*
$a_2$ Eyes concealed; colorless, subterraneous species.
  $b_2$ Ventral fins present ..... 2. *Amblyopsis.*
  $b_2$ Ventral fins wanting ..... 3. *Typhlichthys.*

**1. Chologaster** Agassiz. Body very slender; eyes present; no ventral fins; pyloric cæca 2: 3 species, in swamps and caves.

**Key to the Species of Chologaster**

$a_1$ Lateral papillary ridges absent.
  $b_1$ Three narrow lateral stripes ..... *C. cornutus.*
  $b_2$ Body without stripes ..... *C. agassizii.*
$a_2$ Papillary ridges present ..... *C. papilliferus.*

*C. cornutus* Ag. Length 45 mm.; head 3.4; depth 5.5 to 6.5; color dark brown above; lower half abruptly white; while body sprinkled with black dots; 3 narrow lateral stripes present; rays of dorsal and anal fins 8 or 9; scales 68: lowland swamps from Dismal to Okefinokee Swamps; locally very common.

*C. agassizii* Putnam. Length 30 mm.; head 4; color light brown: Mammoth Cave and other subterranean streams in Tennessee and Kentucky.

*C. papilliferus* Forbes. Length 30 mm.; head 4; depth 5 or 6; color as in *C. cornutus;* pectoral reaching half way to the dorsal fin; head with rows of tactile papillæ: caves in Union and Pope Counties, Illinois.

**2. Amblyopsis** DeKay. Eyes rudimentary and not functional; body and head with many vertical tactile ridges; 1 pyloric cæcum: 1 species.

*A. speleus* DeK. Length 125 mm.; head 3; depth 4.5; body colorless, translucent; rays of dorsal fin 9; anal 8: Mammoth Cave, and other subterranean streams in Kentucky and Indiana; common.

**3. Typhlichthys** Girard. Similar to *Amblyopsis*, except that it has no ventral fins: 1 species.

*T. subterraneus* Gir. Length 50 mm.; colorless and translucent; rays of dorsal and anal fins 7 or 8: subterranean streams from Indiana to Alabama; common.

**Order 7. Synentognathi.**—Garpike. Soft-rayed fishes with unmodified anterior vertebræ; air bladder without pneumatic duct in the adult; no pyloric cæca; fins without spines; ventral fins abdominal; no adipose fin; lower pharyngeal bones fully united: 4 families of marine fishes, one species of which enters the rivers along the Atlantic coast.

**Family Exocœtidæ.**—Body very elongate and slender, covered with small scales; lateral line very low, running along the side of the belly; jaws elongated to form a beak, each jaw with a band of sharp teeth; about 50 species of voracious, carnivorous fishes.

**Tylosurus** Cocco. With the characters of the family; no vomerine teeth; tail fin unequally forked: many species, mostly American.

*T. marinus* (Walbaum). Garfish; billfish. Length 1,200 mm.; head 2.8; depth 5.5; color greenish; sides silvery, with a narrow silvery lateral stripe; a dark bar on the front of the opercle; rays of dorsal fin 15; anal 17; scales 300, 240 before the dorsal fin; body slender, cylindrical: marine, along the Atlantic coast from Cape Cod to Texas, ascending the rivers and often breeding in fresh water; very common.

**Order 8. Acanthopteri.**—The spiny-rayed fishes. Anterior vertebræ unmodified and without Weberian ossicles; ventral fins usually more or less anterior in position, being either thoracic or jugular, and possessing normally 1 spine and 5 soft rays; anterior rays of dorsal and usually also of anal fins spinous, except in suborders 9 and 10; scales typically ctenoid; margin of mouth formed by the premaxillaries alone; air bladder typically without pneumatic duct in the adult: about 30 suborders, mostly of marine fishes, of which 10 suborders (in the United States) include fresh water fishes.

**Key to these Suborders of the Acanthopteri**

$a_1$ Ventral fins more or less abdominal in position.
  $b_1$ Dorsal fin preceded by 2 or more free spines; sticklebacks. 1. *Hemibranchii.*
  $b_2$ No free dorsal spines.
    $c_1$ One dorsal fin..... 2. *Salmopercæ.*
    $c_2$ Two dorsal fins..... 3. *Percesoces.*
$a_2$ Ventral fins thoracic or jugular in position.
  $b_1$ Fins with spines.
    $c_1$ Body covered uniformly with scales.
      $d_1$ Spinous dorsal with less than 16 spines.

$e_1$ Dorsal spines 6 to 15 in number..... 4. *Percoidei.*
$e_2$ Dorsal spines 2 to 8..... 8. *Gobioidei.*
$d_2$ Spinous dorsal with 16 or more spines.
$e_1$ In California..... 5. *Holconoti.*
$e_2$ In Texas..... 6. *Chromides.*
$c_2$ Body not uniformly scaled or without scales..... 7. *Loricati.*
$b_2$ Fins without spines.
$c_1$ Head symmetrical..... 9. *Anacanthini.*
$c_2$ Head asymmetrical; flatfish..... 10. *Heterostomata.*

**Suborder 1. Hemibranchii.**—Gills normal (in Gasterosteidæ), but with the pharyngeals reduced in number; upper jaw formed by the premaxillaries: 5 families of mostly marine fishes, 1 family with fresh water representatives.

**Family Gasterosteidæ.**—Sticklebacks. Body elliptical, rather slender, compressed; caudal peduncle slender; tail fin small; no true scales present, but body either naked or protected laterally by vertically elongate bony plates; 2 to 15 free spines in front of the dorsal fin; a patch of naked skin between the pectoral fin and the opercle on each side; ventral fins consist of 1 spine and 1 or 2 rays and subabdominal in position; middle and sides of belly protected by the pubic bones: 5 genera and about 12 species in America and Europe, 6 in the United States; small fishes living in fresh waters and arms of the sea, most of which build elaborate nests in which the eggs are deposited and where they and the young are protected by the male; they are savage little fish and very destructive to the eggs and young of larger fishes.

**Key to the Fresh Water Genera of Gasterosteidæ in the United States**

$a_1$ Free dorsal spines 3 to 5.
$b_1$ Sides protected by bony plates..... 1. *Gasterosteus.*
$b_2$ Sides naked.
$c_1$ Free dorsal spines 5..... 2. *Eucalia.*
$c_2$ Free dorsal spines 3..... 4. *Apeltes.*
$a_2$ Free dorsal spines 7 to 11..... 3. *Pygosteus.*

**1. Gasterosteus** L. Sides of body usually protected by vertically elongated plates; 3 free dorsal spines; pubic bones broad and little divergent, joined on the belly, forming a median ventral plate behind and between the ventral fins; gill membranes joined to the isthmus: several species in America and Europe, 3 in fresh water in America.

**Key to these Species of Gasterosteus**

$a_1$ In the eastern States..... *G. bispinosus.*
$a_2$ On the Pacific slope.
$b_1$ Body wholly mailed..... *G. cataphractus.*
$b_2$ Body not wholly mailed..... *G. williamsoni.*

*G. bispinosus* Walbaum. Length 100 mm.; head 3.5; depth 4.5; color dark greenish above; sides silvery or yellow; ventral membrane often red; dorsal spines long and slender; rays of dorsal fin II-I, 13; anal I, 9; lateral plates 33; caudal peduncle very slender: Atlantic coast from New Jersey to Labrador, ascending the streams; very common in New England.

*Subspecies of G. bispinosus*

*G. b. atkinsi* Bean. Head 3.3; depth 4.75; lateral plates 10 to 22; rays of dorsal fin II-I, 12; anal I, 8: fresh waters of Maine and Quebec.

*G. b. cuvieri* Girard. Head 4; depth 5.5; rays of dorsal fin II-I, 12; anal I, 8; lateral plates 4, on the anterior part of the body: east coast of America from Labrador to Massachusetts, in fresh and brackish water; not common, except northwards.

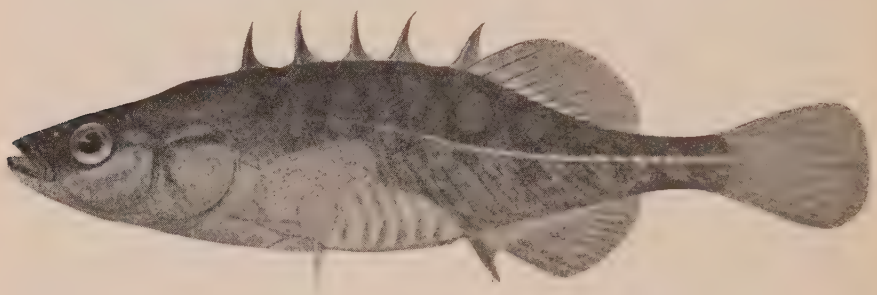


FIG. 48.—*Eucalia inconstans* (*from Fishes of Illinois*).

*G. cataphractus* (Pallas). Alaska stickleback. Very close to *G. bispinosus* but more robust: Pacific coast, from San Francisco to Alaska, ascending the streams; very common.

*G. williamsoni* Gir. Similar to *G. bispinosus*, but the lateral plates are nearly always wanting, or when present there are 2 or 3 on the anterior part of the body; head 3.25 to 3.5; depth 3.25 to 4; dorsal spines very small and weak; rays of dorsal fin II-I, 10; anal I, 8; males with a red head: streams of southern California; very common.

*Subspecies of G. williamsoni*

*G. w. microcephalus* Gir. Lateral plates varying from 0 to 25, usually 5 or 6 at the anterior end; dorsal spines stout: Pacific slope from Alaska to Lower California; common southwards.

**2. Eucalia** Jordan. Body naked; dorsal spines 5; gill membranes forming a fold across the isthmus; pubic bones joined, forming a median ventral plate: 1 species.

*E. inconstans* (Kirtland). Brook stickleback (Fig. 48). Length 65 mm.; head 3.5; depth 4; color of males in spring jet black, tinged with red anteriorly; females olivaceous, mottled and dotted with black; rays of dorsal fins IV-I, 10; anal I, 10: western New York to Kansas and northward to Saskatchewan; in small streams; common.

*Subspecies of E. inconstans*

*E. i. cayuga* Jord. Size smaller; ventral plate U-shaped instead of V-shaped; ventral spines as long as pubic bones: Ithaca and Syracuse, N. Y.

*E. i. pygmæa* (Agassiz). Size small; rays of dorsal fins III or IV-I, 6; anal I, 6: Lake Superior.

**3. Pygosteus** Brevoort. Body naked except for small bony plates along the base of the median fins; free dorsal spines 9 to 11, diverging right and left; pubic bones weak; gill membranes as in *Eucalia:* 2 species, 1 of which, *P. sinensis,* in China.

*P. pungitius* (L.). Ten-spined stickleback. Length 75 mm.; head 4; depth 5 or 6; color olivaceous, punctulate, irregularly barred with darker; rays of dorsal fin VIII or IX-I, 9; anal I, 8: Atlantic coast of America and Europe, from Long Island to the Arctic, ascending the rivers; also in tributaries of the Great Lakes and northward to Alaska; often very common.

**4. Apeltes** Dekay. Body naked; back rather elevated; 3 strong free dorsal spines; tail very slender; pubic bones weak, not joined in the median line; gill membranes joined to isthmus: 1 species.

*A. quadracus* (Mitchill). Four-spined stickleback. Length 50 mm.; head 4; depth 4; rays of dorsal fin III-I, 11; anal I, 8; colorbrownish olive above; silvery below; male almost black; body stout: Maine to New Jersey, in salt water, often ascending the streams; very common northward.

**Suborder 2. Salmopercæ.**—The trout perch. Adipose fin present; ventral fins abdominal; dorsal, anal and ventral fins each with 1 or 2 spines; maxillary toothless and not forming the margin of the mouth; scales ctenoid; head scaleless; pseudobranchiæ present: 1 family.

**Family Percopsidæ.**—Body elongate; caudal peduncle long and slender; mouth small, horizontal; branchiostegals 6; tail forked; stomach siphonal with 10 pyloric cæca: 2 genera.

**1. Percopsis** Agassiz. Body slender, pellucid; dorsal fin with 2 feeble spines; anal with 1: 1 species.

*P. guttatus* Ag. Trout perch. Length 150 mm.; head 3.75; depth 4.3; color pale olivaceous, with a silvery stripe along the lateral line;

upper half of body with dark round spots; rays of dorsal fin II, 9; anal I, 7; scales 6-50-7: Delaware and Potomac Rivers to Kansas, and northward to Hudson Bay; common in the Great Lakes.

**2. Columbia** Eigenmann. Body rather robust; dorsal and anal fins with 2 strong spines each; posterior margin of preopercle with a few short spines; lateral line imperfect: 1 species.

*C. transmontana* Eig. Length 100 mm.; head 3; depth 3.5; color greenish, upper half of body with large dark spots; rays of dorsal fin II, 9; anal II, 6; scales 7 to 9-44 to 46-7: lagoons along the Columbia River; locally common.

**Suborder 3. Percesoces.**—Ventral fins abdominal, with rays I, 5; dorsal spines few, usually forming a separate fin; scales usually cycloid;

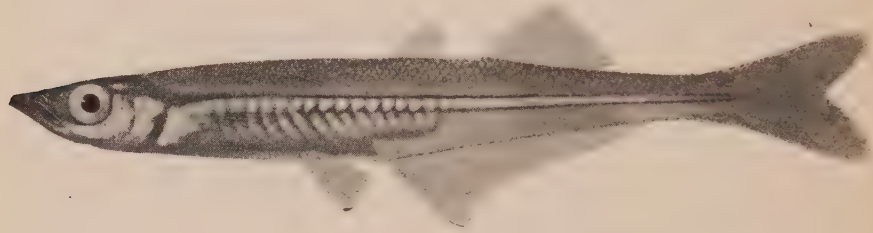


FIG. 49.—*Labidesthes sicculus* (*from Fishes of Illinois*).

pectoral fins elevated and on a level with the posterior angle of the opercle: 3 families, mostly marine.

**Family Atherinidæ.**—Silversides. Body elongate, somewhat compressed; pseudobranchiæ present; 2 dorsal fins, the anterior with spinous rays; anal fin long; no lateral line; no pyloric cæca; branchiostegals 5 or 6: 15 genera and about 60 species, which live along the sea coasts of the warmer continents; a few species are found in rivers.

**1. Menidia** Bonaparte. Body elongate; mouth small, very oblique; premaxillaries protractile; teeth in bands, none on the palatines or vomer; a silvery band along the sides; tail fin deeply forked: 10 species, all American, mostly marine, some entering rivers.

*M. audens* Hay. Length 75 mm.; head 4.5; depth 6; color transparent green, with a lateral silvery band; rays of dorsal fins IV or V-I, 8 or 9; anal I, 17 or 18; scales 45-10: Mississippi River between Vicksburg and Memphis.

*M. beryllina* (Cope). Length 65; head 4.3; depth 5 to 5.5; color pale olive with a well defined lateral silvery band; rays of dorsal fins V-I, 9 to 11; anal I, 15 to 18; scales 38 to 40-8; eyes very large: Long Island to the Potomac River, in fresh and brackish water; common locally.

**2. Labidesthes** Cope. Similar to *Menidia* but with the jaws produced to form a short beak: 1 species.

*L. sicculus* (Cope). Brook silversides (Fig. 49). Length 85 mm.; head 4.5; depth 6 to 8; color pale olive green with a distinct lateral silvery band; back dotted with black; rays of dorsal fins IV-I, 9 to 11; anal I, 23; scales 14-75; body very slender: western New York and the Great Lakes to Iowa; southward to Florida and Texas; locally common in ponds and sluggish streams.

**Suborder 4. Percoidei.**—Body covered in most cases with ctenoid scales; head usually with scaly cheeks and opercles; mouth mostly terminal; pseudobranchiæ usually well developed; dorsal fin made up of 2 portions, a spinous anterior and a soft-rayed posterior portion, which may either be confluent or separate; anal fin usually with 1 to 3 spines; ventral fins thoracic, with usually 1 spinous and 5 soft rays; branchiostegal rays 6 or 7; air bladder without duct; pyloric appendages present: about 15 families, in all seas except the Arctic and in fresh waters.

**Key to the Families of Percoidei occurring in Fresh Water**

$a_1$ Ventral fins with rays I, 7; 1 dorsal fin.....1. *Aphredoderidæ.*
$a_2$ Ventral fins with rays I, 3 or 5, typically 5.
  $b_1$ Lateral line wanting; 1 dorsal fin; hinder margin of tail rounded.....2. *Elassomidæ.*
  $b_2$ Lateral line present (except in Microperca), more or less complete.
    $c_1$ Lateral line not extending on to the tail.
      $d_1$ But 1 dorsal fin, in Micropterus with a deep notch between the spinous and soft-rayed portions...3. *Centrarchidæ.*
      $d_2$. Two dorsal fins present.
        $e_1$ Anal spines 1 or 2.....4. *Percidæ.*
        $e_2$ Anal spines 3.....5. *Serranidæ.*
    $c_2$ Lateral line extending on to the tail.....6. *Sciænidæ.*

**Family 1. Aphredoderidæ.**—Body elliptical; caudal peduncle thick; scales ctenoid; sides of head scaly; lateral line imperfect or wanting; pyloric cæca about 12; anus below the preopercle in the adult but behind the ventral fins in the young; tail fin rounded: 1 genus.

**Aphredoderus** LeSueur. With the characters of the family: species.

*A. sayanus* (Gilliams). Pirate perch (Fig. 50). Length 190 mm.; head 3; depth 3.3; color dark olive, speckled with dark dots; 2 dark bars at the base of the tail fin; rays of dorsal fin III to IV, 10 to 11; anal II, 6; scales 9 to 13-45 to 60-12 to 14: Long Island to Texas; up the Mississippi Valley to Minnesota and eastward to Lake Erie.

**Family 2. Elassomidæ.**—Pigmy sunfish. Body elliptical, compressed, very small in size, with rather large cycloid scales; mouth small, with strong teeth; upper jaw protractile; eyes large; cheeks and opercles scaly; no lateral line; 1 dorsal fin: 1 genus.

**Elassoma** Jordan. With the characters of the family: 2 species.

*E. zonatum* Jord. Length 35 mm.; head 3; depth 3.5; color olive green, with fine dots; sides with 11 vertical dark bands; rays of dorsal fin IV to V, 9 or 10; anal III, 5; scales 18-38 to 42-19: southern Illinois to Texas and Alabama; in sluggish streams; not common.

*E. evergladei* Jord. Scales very large, 27 to 30: swamps from Carolinas to Georgia and Florida; common in the Everglades.

Fig. 50.—*Aphredoderus sayanus* (*from Fishes of Illinois*).

**Family 3. Centrarchidæ.**—The sunfish and black bass. Body compressed and more or less shortened; mouth terminal; teeth in villiform bands on the jaws, vomer, and often on the palatines, tongue and hyoids; premaxillaries protractile; maxillaries usually with supplementary bone; pseudobranchiæ imperfect; lateral line present; but 1 dorsal fin, with 6 to 13 spines, the spinous and soft-rayed portions being confluent; 6 to 10 pyloric cæca: 12 genera and about 30 species of fresh water fishes, all but one in the eastern States and all among the most familiar food and game fishes.

**Key to the Genera of Centrarchidæ**

$a_1$ Anal fin relatively long, almost as long as the dorsal.
  $b_1$ Spines of dorsal fin 11 to 13 ..... 1. *Centrarchus.*
  $b_2$ Spines of dorsal fin 5 to 8 ..... 2. *Pomoxis.*
$a_2$ Anal fin relatively short, much shorter than the dorsal.
  $b_1$ Spinous and soft-rayed portions of dorsal fin not separated by a deep notch; depth of body usually more than two-thirds the length.
    $c_1$ Hinder margin of tail convex.
      $d_1$ Spines of anal fin 5 ..... 3. *Acantharchus.*
      $d_2$ Spines of anal fin 3.
        $e_1$ Spines of dorsal fin 9 ..... 7. *Enneacanthus.*
        $e_2$ Spines of dorsal fin 10 ..... 8. *Mesogonistius.*

$c_2$ Hinder margin of tail mostly concave.
$d_1$ Spines of anal fin 5 to 8.
$e_1$ In the region east of the Rockies..... 4. *Ambloplites.*
$e_2$ In the region west of the Rockies..... 5. *Archoplites.*
$d_2$ Spines of anal fin 3.
$e_1$ Teeth present on the tongue..... 6. *Chænobryttus.*
$e_2$ No teeth on the tongue.
$f_1$ Lower pharyngeals narrow with sharp teeth. 9. *Lepomis.*
$f_2$ Lower pharyngeals broad and with blunt teeth..... 10. *Eupomotis.*
$b_2$ Spinous and soft-rayed portions of dorsal fin separated by a deep notch; depth of body about one-third the length. 11. *Micropterus.*

**1. Centrarchus** Curvier & Valenciennes. Body short, deep and strongly compressed; mouth large, with a projecting lower jaw; gill rakers very long; fins very large; hinder margin of tail concave: 1 species.

*C. macropterus* (Lacépède). Round sunfish. Length 150 mm.; head 2.75; depth 2; color yellowish green, with rows of dark spots along the sides; rays of dorsal fin XI to XIII, 12 to 14; anal VII or VIII, 15; scales 5 or 6-38 to 45-15: Virginia to Florida and Louisiana; northward in the Mississippi Valley to southern Illinois, in clear water; locally common.

**2. Pomoxis** Rafinesque. Body strongly compressed, elliptical; mouth large, oblique; lower jaw projecting; supplementary maxillary well developed; scales large, feebly ctenoid; fins large; gill-rakers very long; hinder margin of tail concave: 2 species.

*P. annularis.* Raf. Crappie. Length 300 mm.; head 3; depth 2.3; color silvery olive, mottled with dark green and with indistinct vertical bars; fins very high; rays of dorsal fin VI, 15; anal VI, 18; scales 36 to 48; body rather elongate: Vermont to Dakota, southward to Alabama and Texas; very common in sluggish streams and ponds.

*P. sparoides* (Lacépède). Calico bass. Length 300 mm.; head 3; depth 2.2; color silvery olive, mottled with green or black spots; median fins with dark and pale spots in rows; rays of dorsal fin VII or VIII, 15; anal VI, 17 or 18; scales 40 to 45; body elevated; fins very high: New York to Texas, in coastwise streams; the basins of the Great Lakes and the Mississippi; common in sluggish streams and ponds.

**3. Acantharchus** Gill. Body rather elongate, not much compressed or elevated; mouth rather large, oblique; scales large, cycloid; tail fin rounded; supplementary maxillary present: 1 species.

*A. pomotis* (Baird). Mud sunfish. Length 150 mm.; head 2.6; depth 2; color very dark greenish with several indistinct wide dark lateral

bands; fins dusky; a black spot on the opercle; rays of dorsal fin XI or XII, 10 or 11; anal V, 10; scales 6-43-12: New York to South Carolina, in sluggish coastwise streams; common.

**4. Ambloplites** Rafinesque. Body elliptical, compressed, moderately elevated; mouth large, the lower jaw projecting; supplementary maxillary large; opercle ending in 2 flat points; scales large, somewhat ctenoid, lingual teeth in one patch; gill-rakers less than 10; lateral line complete; dorsal fin much longer than anal; caudal margin concave: 1 species.

*A. rupestris* (Raf.). Rock bass (Fig. 9). Length 300 mm.; head 2.75; depth 2 to 2.5; color olive green, with dark mottlings and a dark spot on each scale; a black opercular spot; eye red and very large; rays

FIG. 51.—*Chænobryttus gulosus* (*from Fishes of Illinois*).

of dorsal fin XI, 10; anal VI, 10; scales 6 or 7-39 to 43-12: Vermont to Manitoba; southward to Alabama, Louisiana and Texas; very common west of the Alleghenies.

**5. Archoplites** Gill. Body elliptical, compressed, elevated; mouth large, oblique, the lower jaw projecting; opercle emarginate; gill-rakers about 20; lingual teeth in 2 patches; scales strongly ctenoid; hinder margin of tail emarginate: 1 species.

*A. interruptus* (Girard). Sacramento perch. Length 500 mm.; head 2.6; depth 2.5; color blackish above, sometimes all over; sides silvery, with about 7 vertical blackish bars; a black opercular spot; rays of dorsal fin XII or XIII, 10; anal VI or VII, 10; scales 7-40 to 51-14: basin of the Sacramento and San Joaquin Rivers; the only percoid fish west of the Rockies.

**6. Chænobryttus** Gill. Similar to *Ambloplites;* opercle convex at the angle; hinder margin of tail emarginate; tongue with teeth: 1 species.

*C. gulosus* (Cuvier & Valenciennes). Warmouth (Fig. 51). Length 250 mm.; head 2.5; depth 2.25; color olive green, clouded with red or blue, yellow below; sides sometimes with scattered dark spots; rays of dorsal fin X, 9 or 10; anal III, 8 or 9; scales 6 or 7-40 to 46-11 or 12; dorsal spines low: Great Lakes to the Carolinas, Georgia and Texas; westward to Iowa and Kansas; common in the south.

**7. Enneacanthus** Gill. Little sunfish. Body short and deep, compressed, ovoid; mouth small; tongue toothless; opercle with 2 flat points on its margin; lateral line sometimes interrupted; supplementary maxillary large; tail margin rounded behind: 2 species.

**Key to the Species of Enneacanthus**

$a_1$ Opercular spot more than half as large as the eye.....*E. obesus.*
$a_2$ Opercular spot less than half as large as the eye.....*E. gloriosus.*

*E. obesus* (Baird). Length 75 mm.; head 2.6; depth 1.8; color olivaceous, with 5 to 8 blackish cross bars; purplish or golden spots on body and fins; a large black opercular spot; rays of dorsal fin IX, 10; anal III, 10; scales 4-32-10: Boston to Florida, coastwise; often common in weedy streams.

*E. gloriosus* (Holbrook). Length 70 mm.; head 2.75; depth 2.25; color dark olive, with numerous small round blue spots which often

*a* *b*

FIG. 52.—Lower left pharyngeal of *Lepomis pallidus: a*, upper aspect; *b*, lateral aspect (*from Fishes of Illinois*).

form irregular cross stripes; opercular spot blue; rays of dorsal fin IX, 10; anal III, 9; scales 3-30-9; body comparatively elongate: New York to Florida, in clear sluggish streams.

**8. Mesogonistius** Gill. Body short, deep, compressed; mouth small; supplementary maxillary small; opercle with 2 flat points; anal fin much smaller than the dorsal; tail rounded behind: 1 species.

*M. chætodon* (Baird). Black-banded sunfish. Length 100 mm.; head 3; depth 1.6; color clouded straw-color, the sides with 6 to 8 conspicuous, irregular black vertical bars; a black opercular spot; rays of dorsal fin X, 10; anal III, 12; scales 4-28-10; body oval: New Jersey to North Carolina, in sluggish streams.

**9. Lepomis** Rafinesque. Sunfish. Body ovate, compressed; back elevated; mouth small or moderate; supplementary maxillary usually reduced to a rudiment or wanting; gill-rakers short; opercle ending behind in a long black convex flap; hinder margin of tail concave, except in *L. symmetricus;* lower pharyngeals (Fig. 52) narrow, with sharp teeth: many species of very familiar American fishes.

**Key to the Species of Lepomis**

$a_1$ Supplementary maxillary bone well developed, but small.
  $b_1$ Body elliptical, the length about two and a half times the depth..... *L. cyanellus.*
  $b_2$ Body ovate, the length about twice the depth.
    $c_1$ Scales 40 to 45..... *L. punctatus.*
    $c_2$ Scales 35..... *L. symmetricus.*
$a_2$ Supplementary maxillary bone rudimentary or wanting.
  $b_1$ Pectoral fin obtuse and not reaching the front margin of the anal fin.
    $c_1$ In the region east of the Alleghenies..... *L. auritus.*
    $c_2$ On the Gulf slope..... *L. miniatus.*
    $c_3$ In the basins of the Great Lakes and the Mississippi.... *L. megalotis.*
  $b_2$ Pectoral fin more or less pointed and reaching the front margin of the anal fin.
    $c_1$ Scales 35 in the lateral line..... *L. humilis.*
    $c_2$ Scales 42 to 52 in the lateral line.
      $d_1$ Body orange spotted..... *L. macrochirus.*
      $d_2$ Body without orange or red spots..... *L. pallidus.*

*L. cyanellus* Raf. Green sunfish. Length 175 mm.; head 3; depth 2.5; color olivaceous, with a brassy lustre on the sides, yellow below; each scale usually with a sky-blue spot; eye red; rays of dorsal fin X, 11; anal III, 9; scales 7-45 to 55-16: Great Lakes to Mexico, not east of the Alleghenies; very common towards the south.

*L. punctatus* (Cuvier & Valenciennes). Length 150 mm.; head 3; depth 2; color olivaceous, everywhere with numerous minute brown dots; rays of dorsal fin X, 11; anal III, 10; scales 6-40 to 45-13: South Carolina to Florida, in lowland streams.

*L. symmetricus* Forbes. Length 75 mm.; head 2.75; depth 2.25; color dark green, each scale with a brown spot at its base; a black opercular spot present; rays of dorsal fin X, 10; anal III, 9; scales 6-35-10; mouth moderate, with projecting lower jaw; hinder margin of tail convex: Illinois to Texas; not rare southwards.

*L. auritus* (L.). Yellow belly. Length 200 mm.; head (without flap) 3; depth 2 to 2.5; color olive; belly and lower fins orange red; opercular flap very long and narrow; rays of dorsal fin X, 11 or 12;

anal III, 8 to 10; scales 6-43 to 48-15: Maine to Louisiana, east of the Alleghenies; common.

*L. miniatus* Jordan. Length 150 mm.; head 2.75; depth 2.25; sides of male with about 14 rows of red spots; middle of the side with a few scales with black spots; belly orange with red spots; rays of dorsal fin X, 10; anal III, 9; scales 4-40-11: Texas to Indiana River, in lowland streams; common near New Orleans.

*L. megalotis* (Raf.). Long-eared sunfish. Length 200 mm.; head (without flap) 3; depth 1.6 to 2.5; color blue above, orange below; sides with orange spots; head with blue stripes and reticulations; opercular flap very long and broad; rays of dorsal fin X, 10 to 12; anal III, 8 to 10; scales 5-36 to 45-14: Great Lakes to Texas; westward to Minnesota; eastward to North Carolina; common.

*L. humilis* (Girard). Spotted sunfish. Length 100 mm.; head 2.75; depth 2.25; color bluish with greenish specks posteriorly; opercle

*a* *b*

FIG. 53.—Lower left pharyngeal of *Eupomotis gibbosus: a*, upper aspect; *b*, lateral aspect (*from Fishes of Illinois*).

with 4 red bands; sides with many rounds orange spots; belly pink; eye red; rays of dorsal fin X, 10 or 11; anal III, 8 or 9; scales 5-34 to 42-11: Ohio and Kentucky to Dakota; southward to Texas; locally common.

*L. macrochirus* Raf. Length 125 mm.; head 3; depth 2.3; color blue with many orange spots which cover nearly the entire surface, so arranged that the ground color forms a series of vertical bars; no blue stripes on the cheek; rays of dorsal fin X, 12; anal III, 10; scales 6-42-15: Ohio Valley and southwestward to Arkansas; rare.

*L. pallidus* (Mitchill) Bluegill. Length 300 mm.; head 3; depth 2; color olive green; belly yellow or brown; sides with greenish cross bars; no blue stripes on the cheeks or red on the fins; rays of dorsal fin X, 11 or 12; anal III, 10 to 12; scales 7-43 to 52-16: Great Lakes and Minnesota to Florida and the Rio Grande; east of the Alleghenies from New Jersey southward; very common in quiet streams and ponds.

**10. Eupomotis** Gill & Jordan. Sunfish. Very similar to *Lepomis*, but with lower pharyngeal bones (Fig. 53) broad and concave and with unt teeth; no supplementary maxillary: 5 species.

**Key to the Species of Eupomotis**

$a_1$ No scarlet on the opercular flap.
  $b_1$ In the southern States.
    $c_1$ Lower border of opercular flap pale; scales 42 ..... *E. pallidus.*
    $c_2$ Border of opercular flap blood red in male, pale in female; scales 34 to 39 ..... *E. heros.*
    $c_3$ Border of opercular flap orange; scales 42 to 44 ..... *E. holbrooki.*
  $b_2$ In the Great Lake region ..... *E. euryorus.*
$a_2$ Lower posterior border of opercular flap scarlet ..... *E. gibbosus.*

*E. pallidus* (Agassiz). Length 175 mm.; head 2.75; depth 2.4; color light olive, without markings; rays of dorsal fin X, 10; anal III, 9; scales 8-42-12: Georgia to Texas; rare.

*L. heros* (Baird & Girard). Head 3; depth 2.4; color dark greenish above, yellowish below; rays of dorsal fin X, 11; anal III, 11; scales 6-34 to 39-14: Indiana to Florida and the Rio Grande basin; rare.

*E. holbrooki* (Cuvier & Valenciennes). Length 250 mm.; head 3 to 3.5; depth 2 to 2.25; color dusky olive; silvery below; throat yellow; rays of dorsal fin X, 10 to 12; anal III, 9 to 11; scales 6-44 or 45-15: Virginia to Florida; common in lowland streams.

*E. euryorus* (McKay). Length 200 mm.; head 3.75; depth 2.4; color mottled olive; yellowish below; top of head blackish; rays of dorsal fin X, 11; anal III, 10; scales 6-43-14; body very robust, oval: Great Lakes region; very rare.

*E. gibbosus* (L.). Common sunfish; pumpkin-seed. Length 200 mm.; head 3 to 3.25; depth 1.75 to 2; color greenish olive above, shaded with bluish; sides spotted with orange; belly orange yellow; rays of dorsal fin X, 10 to 12; anal III, 10 or 11; scales 6-40 to 47-13; body ovate: Maine to Minnesota; southward east of the Alleghenies to Florida, but rather rare towards the south; in the northern parts only of the Mississippi Valley; very common, especially in ponds; eggs deposited in a nest made in shallow water by the male, who scoops out a depression in the bottom about a foot in diameter and several inches deep, which he guards after the eggs are laid and the young are hatched.

11. **Micropterus** Lacépède. Black bass. Body elongate; mouth very large, oblique; lower jaw projecting; supplementary maxillary bone broad; scales small, ctenoid; lateral line complete; dorsal fin with a deep notch between the spinous and the soft-rayed portions; hinder margin of tail concave: 2 species, both very important game and food fishes.

**Key to the Species of Micropterus**

$a_1$ Maxillary not extending back of the eye (Fig. 54) ..... *M. dolomieu.*
$a_2$ Maxillary extending back of the eye (Fig. 54) ..... *M. salmoides.*

*M. dolomieu* Lac. Small-mouthed black bass. Length 600 mm.; head 2.5 to 3.5; depth 3.3; color a uniform dull green, with a golden lustre; 3 longitudinal bands of the head back of the eye; young with dark spots; rays of dorsal fin X, 13 to 15; anal III, 10 to 12; scales 11-72 to 78-25: Lake Champlain to Manitoba; southward to South Carolina and Arkansas; common, especially in clear, cool streams and lakes; introduced into New England and many other places.

*M. salmoides* (Lac.). Large-mouthed black bass. Length 750 mm.; extreme weight 20 lbs.; head 3 to 3.5; depth 3 to 3.25; color dark green, silvery below; adult plain, young with a broad blackish lateral band;

FIG. 54.—Black bass heads: *a*, head of *Micropterus dolomieu; b*, head of *M. salmoides* (*from Jordan & Evermann*).

3 longitudinal bands on the head back of the eye; rays of dorsal fin X, 12 to 13; anal III, 10 or 11; scales 7-65 to 70-18: Great Lakes region to Dakota; southward to Florida and Mexico; common, especially in lakes and sluggish waters.

**4. Family Percidæ.**—The perch and darters. Body elongate or elliptical; scales ctenoid and small; lateral line usually present; mouth terminal or inferior; opercle usually ending in a flat spine; branchiostegals 6 or 7; 2 dorsal fins, anterior with 6 to 16 spines; anal fin with 1 or 2 spines; ventral fins thoracic, with rays I, 5; air bladder small, often wanting; pyloric caeca few: about 23 genera and 120 species, inhabiting the fresh waters of the northern hemisphere.

**Key to the United States Genera of the Percidæ**

$a_1$ Pseudobranchiæ well developed; branchiostegals 7.
  $b_1$ Ventral fins close together; *Subfamily* 1. *Percinæ*..... 1. *Perca.*
  $b_2$ Ventral fins separated by a space; *Subfamily* 2. *Luciopercinæ*..... 2. *Stizostedion.*
$a_2$ Pseudobranchiæ imperfect or wanting; branchiostegals 6; small, often diminutive, fishes, exclusively American; *Subfamily* 3. *Etheostominæ.*

$b_1$ Parietal region of skull flattened or depressed.
$c_1$ Snout projecting beyond the mouth..... 3. *Percina.*
$c_2$ Snout not projecting beyond the mouth.
$d_1$ Body compressed, not hyaline or extremely elongate.
$e_1$ Premaxillaries not protractile.
$f_1$ Midventral line with enlarged scales or scaleless..... 4. *Hadropterus.*
$f_2$ Scales in the midventral line like those on the sides of the body..... 5. *Hypohomus.*
$e_2$ Premaxillaries protractile.
$f_1$ Anal spines 2.
$g_1$ Ventral fins well separated..... 6. *Cottogaster.*
$g_2$ Ventral fins close together.
$h_1$ Vomer teeth present..... 7. *Ulocentra.*
$h_2$ Vomer teeth absent..... 8. *Diplesion.*
$f_2$ One anal spine present..... 9. *Boleosoma.*
$d_2$ Body depressed, hyaline and very elongate.
$e_1$ Premaxillaries not protractile..... 10. *Crystallaria.*
$e_2$ Premaxillaries protractile.
$f_1$ One anal spine present..... 11. *Ammocrypta.*
$f_2$ Anal spines 2..... 12. *Ioa.*
$b_2$ Parietal region of skull convex; belly with ordinary scales; ventral fins close together.
$c_1$ Lateral line wholly or partially present.
$d_1$ Lateral line straight.
$e_1$ Head naked above..... 13. *Etheostoma.*
$e_2$ Head scaly above..... 14. *Psychromaster.*
$d_2$ Lateral line arched towards the back.
$e_1$ Head scaly above..... 15. *Copelandellus.*
$e_2$ Head naked above..... 16. *Boleichthys.*
$c_2$ Lateral line wanting..... 17. *Microperca.*

**1. Perca** L. Body elliptical, compressed; cheek scaly; opercle mostly naked and armed with a single spine; preopercle serrated; mouth terminal; branchiostegals 7; pseudobranchiæ small, but well developed; pyloric cæca 3; caudal margin concave: 3 species, *P. fluviatilis* occurring in Europe, and *P. schrenki* in Asia.

*P. flavescens* (Mitchill). Yellow perch; common perch. Length 300 mm.; head 3.25; depth 3.25; back elevated; color dark olive green above; sides yellow with 6 to 8 broad dark transverse bars; belly bright yellow; lower fins orange; rays of dorsal fins XIII to XV-II, 13 to 15; anal II, 7 or 8; scales 7-74 to 88-17: Nova Scotia to North Carolina, in coastwise streams; throughout the Great Lakes region and westward to Iowa and Dakota; not found from central Ohio southwestward; very common; introduced on the Pacific slope. The perch spawns in the

spring, laying its eggs in a single mass which stretches out ribbon-like, sometimes 7 feet or more.

**2. Stizostedion** Rafinesque. Body elongate; fusiform; head long; premaxillaries protractile; top of head scaly; mouth large; jaws equal; tail forked; ventral fins well separated; lateral line continuous; branchiostegals 7; pseudobranchiæ well developed: 2 species, both important food and game fishes.

**Key to the Species of Stizostedion**

$a_1$ Cheek and opercle sparsely scaled.....*S. vitreum.*
$a_2$ Cheek and opercle fully scaled.....*S. canadense.*

*S. vitreum* (Mitchill). Wall-eye pike; pike-perch (Fig. 55). Length up to 900 mm.; weight up to 25 lbs.; head 3.6; depth 4.5; color dark olive green, blotched with darker; belly pinkish; anterior dorsal fin with

FIG. 55.—*Stizostedion vitreum* (*from Jordan & Evermann*).

a large black spot on its hinder part; rays of dorsal fins XII to XVI-19 to 21; anal II, 12 to 14; scales 10-110 to 132-25; pyloric cæca 3, of nearly equal length; sides of head almost naked; Vermont and Pennsylvania to Saskatchewan; southward to Georgia; northward to Hudson Bay; very common northward.

*S. canadense* (Smith). Sauger; sand pike. Length 450 mm.; head 3.5; depth 4.5 to 6; color olive gray; sides brassy or orange, with dark mottlings; spinous dorsal fin with 3 irregular rows of black spots; rays of dorsal fins XI to XV-I, 17 to 19; anal II, 11 or 12; scales 9-100 to 125-27; pyloric cæca 5 to 8, of unequal length; sides of head scaly: Great Lakes and St. Lawrence regions; westward to Montana; southward to Tennessee and Arkansas.

*Subspecies of S. canadense*

*S. c. griseum* (DeKay). Head less completely scaled; head bones and opercles smoother: Great Lakes and southward.

*S. c. boreum* (Girard). Head slender: upper Missouri.

**3. Percina** Haldeman. Body slender, elongate, slightly compressed; midventral line with enlarged plates, which may fall off leaving a naked strip; caudal margin concave; mouth overhung by snout; teeth on vomer and palatines; lateral line continuous; air bladder and pseudobranchiæ rudimentary: 2 species.

*P. caprodes* (Rafinesque). Log-perch. Length 200 mm.; head 4 to 4.7; depth 5 to 6.5; color yellowish green, with about 15 black transverse bars extending from the back to the belly and alternating with shorter ones; a round spot at the base of the tail fin; rays of dorsal fin XIII to XVII-12 to 17; anal II, 9 to 12; scales 9-90 to 95-15: Great Lakes region to North Carolina, Mississippi and the Rio Grande; in Atlantic coastal streams sothward to North Carolina; in large, clear streams; generally common.

*P. rex* Jordan & Evermann. Length 150 mm.; head 4; depth 4.6; scales 11-83 to 85-19; anterior dorsal fin with a broad orange band towards the margin: Roanoke River; rare.

**4. Hadropterus** Agassiz. Black-sided darters. Body very small, elongate, cylindrical, brightly colored, with a series of large dark more or less confluent blotches along the lateral line and rounded blotches on the back; mouth terminal; teeth on jaws and vomer and usually the palatines; midventral area with enlarged scales which in most species may be shed, leaving the belly naked; fins large; ventral fins well separated: about 12 species.

**Key to the Species of Hadropterus**

$a_1$ Median line of belly naked as far as the anus.
  $b_1$ Species west of the Alleghenies.
    $c_1$ Ventral fins widely separated.
      $d_1$ Color blotches more or less transverse.....*H. evermanni.*
      $d_2$ Color blotches more or less longitudinal.
        $e_1$ Lower jaw as long as the upper.....*H. phoxocephalus.*
        $e_2$ Lower jaw shorter than the upper.
          $f_1$ Scales very small, about 90 in the lateral line.*H. macrocephalus.*
          $f_2$ Scales 50 to 70 in the lateral line.
            $g_1$ Cheeks scaly; scales 60 to 70.....*H. aspro.*
            $g_2$ Cheeks usually naked; scales 50 to 60...*H. ouachitæ.*
    $c_2$ Ventral fins not widely separated; cheeks naked.....*H. evides.*
  $b_2$ Species east of the Alleghenies.
    $c_1$ Scales 52 to 56.....*H. peltatus.*
    $c_2$ Scales 48.....*H. roanoka.*
$a_2$ Median line of belly scaly, at least posteriorly.
  $b_1$ In the Mississippi Valley.....*H. sciurus.*
  $b_2$ In the southern and Gulf States.....*H. nigrofaciatus.*

*H. evermanni* Mœnkhaus. Length 100 mm.; head 4; depth 5; color olive, marbled; sides with 13 or 14 blotches; rays of dorsal fins XIII-14; anal II, 12; scales 8-69-8 to 12; cheeks and opercles scaly: northern Indiana and Illinois; rare.

*H. phoxocephalus* (Nelson). Length 150 mm.; head 4; depth 5.5 to 6; color yellowish brown, with the lateral blotches elongate; cheek and opercle scaly; rays of dorsal fins XI or XII-12 to 14; anal II, 8 or 9; scales 12-80 to 85-16; head very slender; a strong opercular spine; pyloric cæca 2: Ohio to Iowa; southward to Tennessee and Oklahoma; in sandy rivers; locally common.

*H. macrocephalus* (Cope). Length 75 mm.; head 3.5 to 4; depth 6 or 7; color light brown, with 9 spots on the side; rays of dorsal fins XIII to XIV-12 to 14; anal II, 9 to 11; scales 11-88 to 90-16; cheek naked or with rudimentary scales; opercle with small cycloid scales; a small spot at the base of the tail fin: west slope of the Alleghenies, from Pennsylvania southwards; in clear rivers; scarce; not in brooks.

FIG. 56.—*Hadropterus aspro* (*from Jordan & Evermann*).

*H. aspro* (Cope & Jordan) (Fig. 56). Length 100 mm.; head 4; depth 5 or 6; color yellowish or greenish, with about 10 elongate blotches along the sides; rays of dorsal fins XIII to XV-11 to 13; anal II, 8 to 10; scales 9-65 to 70-11; cheek with small scales, opercle with larger ones; pyloric cæca 3: Great Lakes to Manitoba; eastward and southward to the James, the Ohio Valley and to Arkansas; common in clear streams; not common in small brooks.

*H. peltatus* (Cope). Length 100 mm.; head 4; depth 5.6; color light yellow, with 6 large, squarish lateral blotches and faint bars between; cheek naked; opercle scaled above; rays of dorsal fins XIII-12; anal II, 10; scales 6-52 to 56-9: southeastern Pennsylvania to South Carolina, in coastwise streams; locally common.

*H. ouachitæ* (Jordan & Gilbert). Length 60 mm.; head 4; depth 6.5; color olivaceous, with about 5 rather black bars extending downward

from the back to the lateral line and 8 or 9 dusky quadrate lateral blotches; rays of dorsal fins XI or XII-13; anal II, 10; scales 6-52 to 60-10: southern Indiana to Arkansas; not rare.

*H. roanoka* (Jordan & Jenkins). Length 60 mm.; head 4; depth 4.75; color light yellow, with dark green markings and 10 or 11 vertical green lateral confluent bars; anterior dorsal fin with a median band of bright yellow; female pale; rays of dorsal fins X or XI-11; anal II, 8 or 9; scales 5-48-9; body robust: southern Virginia and North Carolina; common.

*H. evides* (Jordan & Copeland). Length 75 mm.; head 4.3; depth 5.3; color extremely brilliant, olivaceous or yellow above, mottled with darker with about 7 broad transverse green (male) or black (female) bars extending from the back down the sides, connected by an orange-brown lateral line; rays of dorsal fins XI-10; anal II, 8 or 9; scales 9-52 to 67-9 to 11; cheeks not scaly: Indiana, in the Maumee and Wabash basins, to central Iowa; southward to Arkansas and North Carolina; often common.

*H. scierus* Swain. Length 75 mm.; head 4 to 4.8; depth 5 or 6; color yellowish olive, everywhere vaguely blotched with black; top of head, dorsal anal and caudal fins black; preopercle serrate; cheeks and opercles scaly; gill membranes united; rays of dorsal fins XIII-13 or 14; anal II, 9; scales 7-68 to 70-17; fins very large: northern Indiana to Tennessee and Texas.

*H. nigrofasciatus* Agassiz. Length 150 mm.; head 4; depth 5; color dark olive; sides with 12 narrow vertical bars, confluent along the middle; no red or blue; body stout, compressed; fins large; dorsal fins XII-11 or 12; anal II, 9 or 10; scales 7-58-15: South Carolina to Louisiana, in larger clear streams; often common.

**5. Hypohomus** Cope. Darters. Similar to *Hadropterus*, but with belly covered with scales similar to those on the sides: about 5 species, all quite rare.

**Key to the Species of Hypohomus**

$a_1$ Gill membranes broadly united..... *H. squamatus.*
$a_2$ Gill membranes scarcely united.
  $b_1$ Scales in the lateral line about 100..... *H. aurantiacus.*
  $b_2$ Scales in the lateral line about 65..... *H. cymatotænia.*

*H. squamatus* (Gilbert & Swain). Length 125 mm.; body elongate; head 3.7; depth 5.5; color yellowish olive, with 10 broad dusky bars across the back, and an equal number along the lateral line; a conspicuous black shoulder spot; rays of the dorsal fins XIV-13; anal II, 10;

scales 10-82-18; bill membranes broadly united across the isthmus: upper Tennessee River basin; rare.

*H. aurantiacus* (Cope). Length 150 mm.; head 4.25; depth 6; color olive, with a row of confluent blotches along the side; chin and throat deep orange; rays of dorsal fins XV-15; anal II, 11; scales 14-100-15: upper Tennessee basin.

*H. cymatotænia* (Gilbert & Meek). Length 125 mm.; head 4 to 4.25; depth 5; body robust; color greenish, with fine dots and 2 pale streaks along the sides; a black spot at the base of the tail fin; rays of dorsal fins XII to XIV-12 to 14; anal II, 10; scales 7-64 to 70-12: western Kentucky and southern Missouri.

**6. Cottogaster** Putnam. Body slender; snout blunt; scales ctenoid; midventral space naked anteriorly or with enlarged caducous scales; lateral line continuous; premaxillaries protractile: 5 species.

**Key to the Species of Cottogaster**

$a_1$ Midventral area with more or less enlarged caducous scales.
  $b_1$ Back with 4 broad black cross bands ..... *C. uranidea.*
  $b_2$ Back tessellated ..... *C. copelandi.*
$a_2$ Midventral area naked anteriorly.
  $b_1$ Cheeks and opercles usually scaly ..... *C. shumardi.*
  $b_2$ Cheeks and opercles naked ..... *C. cheneyi.*

*C. uranidea* (Jordan & Gilbert). Length 50 mm.; head 3.5; depth 5.6; color greenish olive; back with 4 conspicuous broad black cross bands and 11 dark blotches below the lateral line; cheeks mostly naked; opercle scaly; rays of dorsal fins X or XI-13; anal II, 10 or 11; scales 6-48 to 56-10: southern Indiana to Alabama and Arkansas, in lowland streams.

*C. copelandi* (Jordan). Length 75 mm.; head 3.75; depth 5.5 to 6.5; color brownish olive, with a series of small black blotches along the lateral line forming an interrupted lateral band; a black spot on the anterior dorsal fin; cheek naked; opercle with a few scales; rays of dorsal fins X to XII-10 to 12; anal II, 8 or 9; scales 6-44 to 56-8: Lake Champlain to Lake Huron and southwestward to Tennessee and southern Missouri; abundant in central Indiana; in clear brooks.

*C. shumardi* (Girard) (Fig. 57). Length 75 mm.; head 3.4; depth 5; color dark, vaguely blotched with darker, with a large black spot at the base of the anterior dorsal fin; caudal and pectoral fins barred; rays of dorsal fins IX to XI-13 to 15; anal II, 10 to 12; scales 6-48 to 60-11: Michigan and Illinois to Kentucky and Arkansas; the Great Lakes; common.

*C. cheneyi* Evermann & Kendall. Length 50 mm.; head 4; depth 6; color dark, with 8 or 9 large detached spots in the lateral line; cheek naked; rays of dorsal fins XI-12; anal II, 8; scales 7-56-6: northern New York; rare.

**7. Ulocentra** Jordan. Darters. Body elongate; head short and thick; scales on belly like those on the sides; premaxillaries protractile; ventral fins close together: 6 species, several rare.

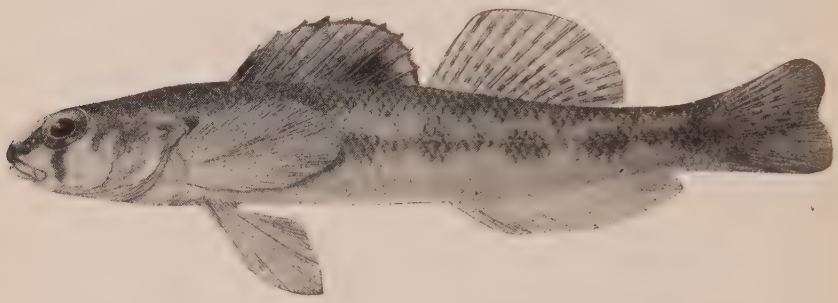


FIG. 57.—*Cottogaster shumardi* (*from Fishes of Illinois*).

**Key to the Species of Ulocentra**

$a_1$ Gill membranes narrowly connected..... *U. stigmæa.*
$a_2$ Gill membranes broadly connected.
  $b_1$ Opercles naked or nearly so..... *U. histrio.*
  $b_2$ Opercles scaly..... *U. simotera.*

*U. stigmæa* (Jord.). Length 60 mm.; head 4.25; depth 5; color olivaceous, speckled above; sides with 8 dark green blotches below the lateral line; rays of dorsal fins X to XIII-12; anal II, 7; scales 5-46 to 55-10; opercle and cheek scaly; lateral line incomplete: Tennessee and Georgia to Arkansas and Louisiana; rather common in pine woods.

*U. histrio* (Jordan & Gilbert). Length 50 mm.; head 4 to 4.25; depth 5 to 5.5; color very dark green, with 7 light dorsal cross bars usually alternating with bars beneath the lateral line; fins all barred; head naked; rays of dorsal fins X-13; anal II, 7; scales 5-50 to 54-10: southern Indiana and Kentucky to Arkansas; common.

*U. simotera* (Cope). Length 75 mm.; head 4 to 4.6; depth 4 to 5; color green; sides with dark blotches; belly yellow; dorsal fins variegated; back spotted with red; rays of dorsal fins X to XII-10 or 11; and II, 7; scales 6-48 to 52-11; snout very short: western Virginia and eastern Kentucky to Alabama; very common in clear streams.

**8. Diplesion** Rafinesque. Body slender; head very blunt; mouth very small, inferior; premaxillaries protractile; gill membrane broadly connected; lateral line complete; pyloric cæca 4: 1 species.

*D. blennioides* (Rafinesque). Green-sided darter (Fig. 58). Length 125 mm.; head 4.5; depth 4.75 to 6; color olive green; sides with about 8 double transverse bars and dotted with orange; second dorsal and anal fins bluish green; rays of dorsal fins XII to XIV-12 to 15; anal II, 8 or 9; scales 6-58 to 78-14: Pennsylvania to South Dakota; southward to the Alabama basin and Kansas; common.

**9. Boleosoma** DeKay. Body elongate; head pointed; premaxillaries protractile; vomer teeth present; scales large; belly with ordinary

FIG. 58.—*Diplesion blennioides* (*from Fishes of Illinois*).

scales; ventral fins well separated; anal fins usually with but one spine; no red or blue in the coloration; pyloric cæca mostly 6: 5 species.

**Key to the Species of Boleosoma**

$a_1$ Lateral line complete; tail fin rounded.
  $b_1$ Pectoral fins one-third or one-half longer than head.
    $c_1$ Scales in lateral line 44 ..... *B. longimanus.*
    $c_2$ Scales in lateral line 35 ..... *B. podostemone.*
  $b_2$ Pectoral fins about as long as head.
    $c_1$ Head more or less scaly ..... *B. nigrum.*
    $c_2$ Head naked ..... *B. susanæ.*
$a_2$ Lateral line incomplete; tail fin emarginate ..... *B. camurum.*

*B. longimanus* (Jordan). Length 60 mm.; head 4.4; depth 5; color green, with 10 small irregular spots on the sides and about 5 cross blotches on the back; cheeks and breast naked; opercles scaly; rays of dorsal fins X-13; anal I, 8; scales 5-44-7: Virginia; abundant in rocky streams.

*B. podostemone* (Jordan & Jenkins). Length 50 mm.; head 4.4; depth 5.6; color yellowish green, with 7 or 8 dark spots along the sides and 5 or 6 larger ones along the back; fins barred; cheeks and breast naked; opercles scaly; rays of dorsal fins X-13; anal I, 8; scales 4-35-6: Roanoke River; common.

*B. nigrum* (Rafinesque). Johnny darter (Fig. 59). Length 60 mm.; head 3.75 to 4.5; depth 5 or 6; color pale olivaceous; back speckled with brown; sides with numerous small black blotches; males in spring black anteriorly; opercles scaly; rays of dorsal fins IX-12 to 14; anal I, 7 to 9; scales 5-44 to 55-9; scales rarely 35 to 40: eastern and central States; westwards to Colorado; northward to Manitoba; very common in most streams, especially in small ones among weeds.

FIG. 59.—*Boleosoma nigrum (from Jordan & Evermann).*

*Subspecies of B. nigrum*

*B. n. olmstedi* Storer. Length 85 mm.; cheek scaly: coastwise streams; south to Virginia.

*B. n. effulgens* (Girard). Cheek and breast naked; color metalic green: Maryland to North Carolina.

*B. n. vexillare* Jord. Cheek naked; rays of dorsal fins VIII or IX-10 to 12; anal I, 7; scales 4-35 to 47-6: Virginia; common.

*B. n. maculaticeps* Cope. Head spotted; cheek naked: Catawba River, North Carolina; common.

*B. susanæ* Jordan & Swain. Length 50 mm.; head 4; depth 6.5; color as in *B. nigrum;* rays of dorsal fins VIII-10 or 11; anal I, 8; scales 4-45 to 50-6; head naked; body very slender: upper Cumberland River, Kentucky; common.

*B. camurum* Forbes. Length 60 mm.; head 4 to 4.5; depth 5.5; to 6.5; color as in *B. nigrum;* rays of dorsal fins IX or X-10 or 11; anal I, 7 or 8; scales 5 or 6-56 to 65-11; lateral line ending near middle of body; cheek and opercle scaly: Indiana to Iowa; southward to Alabama and Texas; common towards the south.

**10. Crystallaria** Jordan & Gilbert. Body elongate and very slender and hyaline; lateral line complete; cheek and opercle scaly; tail forked; premaxillaries not protractile; throat and belly naked: 1 species.

*C. asprella* (Jordan). Length 80 mm.; head 4 to 4.5; depth 7 or 8; color olive, with 4 or 5 dark cross bands on the back and a dark lateral

band; rays of dorsal fins XII to XIV-13 to 15; anal I, 12 to 14; scales 7 to 10-98-10 (83 to 85 in specimens from Alabama): southern Indiana and Illinois to Alabama and Arkansas, in swift streams.

**11. Ammocrypta** Jordan. Similar to *Crystallaria*, but with very protractile premaxillaries: 2 species, both of which have the habit of burying themselves in the sand.

*A. pellucida* (Baird). Sand darter (Fig. 60). Length 75 mm.; head 4 to 4.75; depth 7 to 8.5; body translucent; nose very sharp; a series of small spots along the back and another along each side; cheek and opercle scaly; rays of dorsal fins X-10; anal I, 8 to 10; scales 67 to 78: Lake

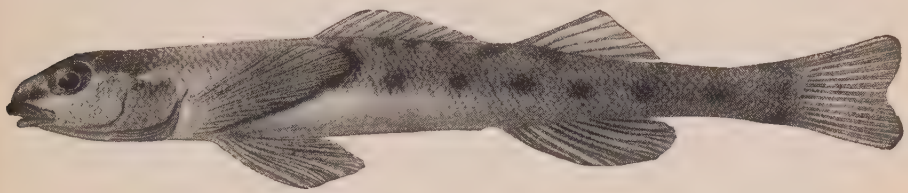


FIG. 60.—*Ammocrypta pellucida (from Fishes of Illinois).*

Erie to Minnesota; southward to Kentucky and Texas; common in clear, sandy streams.

*Subspecies of A. pellúcida*

*A. p. clara* Jordan & Meek. Nuchal region and sides naked anteriorly: Mississippi Valley.

*A. p. vivax* Hay. A dusky bar across the base of the dorsal fin: Mississippi to Arkansas and Texas.

*A. beani* Jord. Length 60 mm.; head 3.75; depth 7.5; color translucent, without bars or spots; anterior dorsal fin spotted; rays of dorsal fins VIII to X-10 or 11; anal I, 9 or 10; scales 65; head and body naked, except the caudal peduncle: Alabama to Louisiana; common in pine woods.

**12. Ioa** Jordan & Brayton. Similar to *Ammocrypta*, but with 2 spines in the anal fin: 2 species.

*I. vitrea* (Cope). Length 50 mm.; head 4 to 4.5; depth 7 to 7.5; color translucent, with small dark spots on the back and sides; rays of dorsal fins VII to IX-11 to 14; anal II, 6 to 9; scales 50 to 62; belly partly naked: eastern Virginia and North Carolina; common.

**13. Etheostoma** Rafinesque. Darters. Body mostly elongate and brightly colored; premaxillaries not protractile; mouth mostly terminal; top of head naked; belly scaled like the sides; fins large; anal fin with 2 spines; pyloric cæca 3 or 4; lateral line straight; ventral fins usually

close together: numerous species of very small fishes, many very variable, which live in small clear streams, largely in mountain regions, in the eastern and central States.

### Key to the Species of Etheostoma

$a_1$ Lateral line complete; species mostly in the basin of the upper Tennessee and Cumberland Rivers.
- $b_1$ Ventral fins separated by a distinct space.
  - $c_1$ Anal fin about as large as the posterior dorsal..... *E. variatum.*
  - $c_2$ Anal fin much smaller than the posterior dorsal.
    - $d_1$ Head entirely naked.
      - $e_1$ Scales in the lateral line 48 to 57..... *E. swannanoa.*
      - $e_2$ Scales in the lateral line 40 to 48..... *E. thalassinum.*
    - $d_2$ Cheeks and opercles scaly..... *E. zonale.*
- $b_2$ Ventral fins near together.
  - $c_1$ Opercles and cheeks naked..... *E. camurum.*
  - $c_2$ Opercles scaly; cheeks naked.
    - $d_1$ Scales in lateral line 56 to 63.
      - $e_1$ Color dark olive; throat blue..... *E. maculatum.*
      - $e_2$ Color yellowish ..... *E. cinereum.*
    - $d_2$ Scales in the lateral line about 45.
      - $e_1$ Nape naked..... *E. rufilineatum.*
      - $e_2$ Nape scaly..... *E. jordani.*

$a_2$ Lateral line more or less incomplete; ventrals close together; species mostly in the Mississippi basin.
- $b_1$ No black spot on shoulder.
  - $c_1$ Cheeks and opercles scaly.
    - $d_1$ Breast naked.
      - $e_1$ Scales in the lateral line 55 to 63..... *E. iowæ.*
      - $e_2$ Scales in the lateral line 47 to 55.
        - $f_1$ Lateral line almost complete..... *E. jessiæ.*
        - $f_2$ Lateral line extending to beneath the second dorsal fin..... *E. luteovinctum.*
    - $d_2$ Breast scaly..... *E. squamiceps.*
  - $c_2$ Cheeks naked; opercles scaly..... *E. cæruleum.*
- $b_2$ A black spot on the shoulder.
  - $c_1$ Gill membranes scarcely connected.
    - $d_1$ Scales in lateral line 63 to 80..... *E. punctulatum.*
    - $d_2$ Scales in lateral line 46 to 55..... *E. cragini.*
  - $c_2$ Gill membranes broadly connected across isthmus.
    - $d_1$ Lower jaw scarcely projecting..... *E. whipplii.*
    - $d_2$ Lower jaw strongly projecting..... *E. flabellare.*

*E. variatum* Kirtland. Body moderately elongate; head short and blunt and very rugose; length 100 mm.; head 3.5 to 4.4; depth 4.8 to 5.5; color greenish; sides and belly orange, with 5 bands posteriorly; anterior dorsal fin with a blue band; female paler; fins very large; rays of dorsal

fins XII to XIV-11 to 13; anal II, 7 to 9; scales 8-51 to 63-12: Ohio basin; rare.

*E. swannanoa* Jordan & Evermann. Body robust; length 75 mm.; head 4.3; depth 6; head naked, very short and blunt; color green, with 6 distinct dark cross blotches on the back and 8 or 10 on the sides; cheeks, opercles and breast naked; rays of dorsal fins XI or XII-12 to 14; anal II, 9; scales 6-48 to 57-7 or 8: upper waters of the Tennessee River; common.

*E. thalassinum* (Jordan & Brayton). Length 60 mm.; head 3.6; depth 4.75 to 5; color dark green, blotches above and with 6 to 9 dark vertical bars; dorsal fins reddish; females duller; head and throat naked; rays of dorsal fins IX to XI-10 to 12; anal II, 7 or 8; scales 5-40 to 48-7: Santee River basin; very abundant.

*E. zonale* (Cope) (Fig. 61). Body slender; length 75 mm.; head 4 or 5; depth 5 or 6; color olivaceous, with large dorsal spots which connect

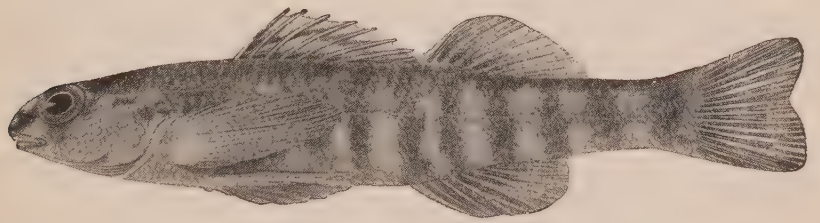


FIG. 61.—*Etheostoma zonale* (*from Fishes of Illinois*).

with a lateral band from which 8 bands encircle the belly; rays of dorsal fins X or XI-10 to 12; anal II, 6 to 8; scales 6-48 to 53-9; cheeks, opercles and throat more or less scaly: Mississippi Valley, from Ohio to Iowa; southward to Alabama and Louisiana; abundant; very variable.

*E. camurum* (Cope). Blue-breasted darter. Body stout; length 60 mm.; head 4; depth 4.5; color dark olive, sprinkled with crimson dots; throat and breast deep blue; posterior dorsal, anal and caudal fins crimson, bordered by yellow and blue; rays of dorsal fins XI-13; anal II, 8; scales 7-50 to 58-8; cheeks and opercles naked; body stout; head blunt: Indiana and Ohio to Tennessee, in swift waters; not common.

*E. maculatum* Kirt. Body elongate with a large tail fin; length 60 mm.; head 4; depth 5.25; color black above, olive below; throat blue; back and sides with crimson dots; anterior dorsal fin with a black spot; tail fin with 2 crimson spots at the base; cheeks naked; opercles scaly; rays of dorsal fins XII-12 or 13; anal II, 8 or 9; scales 9-56 to 63-14: northern Ohio and Indiana to northern Alabama and Tennessee: rare.

*E. cinereum* Storer. Body slender; length 100 mm.; head 3.5; depth 5.5; color light yellow, with 4 dark cross bars on the back and a series of about 12 dark spots along the lateral line; rays of dorsal fins XI or XII-11 to 13; anal II, 8; scales 8-57 to 60-9; opercles scaly; cheeks, breast and nape naked: Tennessee and Cumberland Rivers; rare.

*E. rufilineatum* (Cope). Body stout; length 75 mm.; head 4; depth 4.5 to 5; color green, with narrow longitudinal stripes and quadrate red spots on the sides; breast blue; opercles scaly; cheeks, nape and breast naked; fins variegated, all bordered with scarlet; rays of dorsal fins X to XII-11 to 13; anal II, 8 or 9; scales 6-45 to 48-7: upper tributaries of the Tennessee, Cumberland and Green Rivers; very common.

*E. jordani* Gilbert. Similar to *E. rufilineatum;* color olivaceous, with 8 black cross bars on the back and 9 or 10 irregular blotches on the side; nape and opercles scaly; cheeks and breast naked; shoulder with an enlarged black scale: tributaries of the Coosa River, Alabama; common.

*E. iowæ* Jordan & Meek. Length 50 mm.; body slender; head 3.8; depth 4 to 5.5; color light green, blotches with darker; sides with 10 or 11 large brown spots alternating with black ones; cheeks, opercles and nape scaly; top of head and breast naked; rays of dorsal fins VII to X-10 or 11; anal II, 6 to 8; scales 5-55 to 63-11: Michigan, Iowa and Nebraska, and northward into Canada; common.

*E. jessiæ* (J. & B.). Length 45 mm.; head 4; depth 4.75; cheeks and opercles scaly; color brownish, with a light lateral band, above and below which are light spots; rays of dorsal fins X to XII-12 to 14; anal II,7 to 9; scales 6-47 to 55-8: Indiana to Iowa; southward to Mississippi and Texas; common.

*E. luteovinctum* Gilbert & Swain. Body compressed; length 50 mm.; head 3.6; depth 4.5 to 5; color light olive, with 7 cross bars; sides with 9 greenish blotches alternating with yellowish bands; cheeks and opercles scaly; rays of dorsal fins IX or X-13; anal II, 7 or 8; scales 6-49 to 55-11; tail very slender: Stone River, Tennessee; rare.

*E. cæruleum* Storer. Rainbow darter. Body stout; length 60 mm.; head 3.75; depth 4.25; color olivaceous, blotched with darker; sides with about 12 oblique blue bars with orange between; cheeks blue; breast and throat orange; fins mostly orange and blue; rays of dorsal fins IX to XII-12 to 14; anal II,7 or 8; scales 5-37 to 50-10; neck and breast naked: valleys of the Mississippi and Great Lakes and southwestward to Texas; very common in small streams.

*E. punctulatum* (Agassiz). Body slender; length 50 mm.; head 3.3; depth 5.75; color dark green, with indistinct darker bars; head punctu-

late; belly red; a black spot on shoulder; rays of dorsal fins X or XI-14; anal II, 8 or 9; scales 9-63 to 80-16; breast, cheeks and opercles naked: Ozark region; not common.

*E. cragini* Gilb. Length 40 mm.; head 3.3; depth 4.75; color olivaceous, mottled; lower half of sides specked with black; sides with a series of small spots; a conspicuous shoulder spot; cheeks and opercles naked; rays of dorsal fins VIII or IX-10 to 12; anal II, 6 or 7; scales 6-46 to 55: western portion of Arkansas River basin, in Colorado; in small brooks; the only darter reaching the base of the Rockies.

*E. whipplii* (Girard). Body rather deep, compressed; length 60 mm.; head 3.5; depth 4.5 to 5; color grayish, mottled with darker and about 12 indistinct dusky bars; sides with small scarlet spots and 2 orange spots at the base of the tail fin; a black shoulder spot; rays of dorsal fins XI-11 or 12; anal II, 7 or 8; scales 8-60 to 70; lateral line incomplete; opercles with a few large scales: lower Arkansas basin; common.

*E. squamiceps* Jordan. Body robust; length 75 mm.; head 3 to 4; depth 4.25 to 5; color dusky olive, with about 10 diffuse blackish cross bands; a pinkish streak along the lateral line; no red or blue; cheeks, opercles, nape and breast usually scaly; rays of dorsal fins VIII to XI-9 to 12; anal II, 7 or 8; scales 6-48 to 60-12: southern Indiana to Georgia and western Florida; common southward.

*E. flabellare* Raf. Fan-tailed darter. Body slender; head long and pointed; length 60 mm.; head 3.5 to 4; depth 4.5 to 5.5; color rather dark, body covered with fine specks which form dark cross blotches in the male; a conspicuous shoulder spot; no red or blue; rays of dorsal fins VIII-12 to 14; anal II, 7 to 9; scales 9-40 to 65-14; lower jaw strongly projecting; head naked; tail fin large: New England to northern Alabama; westward to Iowa; abundant in swift waters; variable.

*Subspecies of E. flabellare*

*E. f. lineolatum* (Agassiz). Longitudinal lines of dark dots present: northern Indiana and Missouri to Minnesota.

*E. f. cumberlandicum* Jordan & Swain. Coloration plain, except for the black shoulder spot: Cumberland Mountains.

**14. Psychromaster** Jordan & Evermann. Similar to *Etheostoma*, but differing in having a more robust form, a single anal spine and the top of the head scaly; lateral line curved and incomplete: 1 species.

*P. tuscumbia* (Gilbert & Swain). Body heavy and robust, with an elevated back; length 50 mm.; head 3.5; depth 4; color grayish or greenish, mottled or speckled with black; 6 broad dorsal bars and 8 or 10 black blotches along the lateral line; fins barred; cheeks and opercles

scaly; rays of dorsal fins IX or X-11 to 13; anal I, 8; scales 6-48 to 50-10: northern Alabama; abundant.

**15. Copelandellus** Jordan & Evermann. Similar to *Boleichthys*, but differing in having the top of the head scaly: 1 species.

*C. quiescens* (Jordan). Body compressed, elongate; length 75 mm.; head 3.6; depth 4.6; color dark brown, with bright red and blackish mottlings on the sides and back; a small black shoulder spot; rays of dorsal fins IX to XII-9 to 12; anal II, 7; scales 3-48 to 56-10; cheeks, breast, nape and opercles scaly: Virginia to Florida, in swamps and lowland streams of the coastal plain; not common.

**16. Boleichthys** Girard. Similar to *Etheostoma*, with a curved and incomplete lateral line: 2 species.

*B. fusiformis* (Girard). Body elongate and compressed; length 50 mm.; head 3.5 to 4; depth 3.75 to 6; color very variable, olivaceous, blotched with dusky; a black spot below and another in front of the eye; rays of dorsal fins IX or X-9 to 12; anal II, 6 to 8; scales 3-43 to 60-12; cheek, opercle and nape scaly: entire eastern and central States; westward to Minnesota and the Rio Grande, in lowland streams and ponds.

**17. Microperca** Putnam. Similar to *Etheostoma*, but without a lateral line: 3 species.

**Key to the Species of Microperca**

$a_1$ Cheeks and opercles scaly ..... *M. prælaris.*
$a_2$ Cheeks naked.
  $b_1$ Anal spines 2; in the northwest ..... *M. punctulata.*
  $b_2$ Anal spine 1; in the south ..... *M. fonticola.*

*M. prælaris* Hay. Length 40 mm.; head 4; depth 4.5; color olive, speckled with brown; 10 spots along the sides; rays of dorsal fins VIII-11; anal II,6; scales 36: Alabama to Arkansas, in lowland streams.

*M. punctulata* Putn. Length 30 mm.; head 3.75; depth 4.5 to 5; color light olive, with sides speckled and vaguely barred; rays of dorsal fins VI to VIII-9 or 10; anal II, 6; scales 34 to 37-9; opercles with a few scales: Michigan to Minnesota; southward to Arkansas; common in clear weedy streams and ponds, especially in the Great Lakes basin; the smallest of the darters.

*M. fonticola* (Jordan & Gilbert). Length 30 mm.; head 3.3 to 4; depth 4.5 to 5; color light olive, with 8 cross blotches on the back and horizontal lines on the sides; rays of dorsal fins VI to VII-8 to 10; anal I,7; scales 34: Arkansas and Texas, in clear rocky streams; scarce.

**Family 5. Serranidæ.**—Sea bass. Body elliptical, more or less compressed; scales usually ctenoid; lateral line present; caudal margin of fresh water forms concave; ventral fins thoracic; branchiostegals normally 7; pseudobranchiæ large; spines of dorsal fin 2 to 15; of anal fin 3; cheeks and opercles always scaly; teeth on vomers and palatines: about 70 genera and 400 species, mostly marine; 2 genera and 4 species in fresh water, which are important food and game fishes.

**Key to the Fresh Water Genera of Serranidæ**

$a_1$ Two dorsal fins present and separate ..... 1. *Roccus.*
$a_2$ Two dorsal fins present, joined by a membrane ..... 2. *Morone.*

**1. Roccus** Mitchill. Body deep and strongly compressed; lower jaw projecting; two dorsal fins present; teeth on the base of the tongue: 2 species.

**Key to the Species of Roccus**

$a_1$ In the Atlantic and its tributary streams ..... *R. lineatus.*
$a_2$ In the Mississippi Valley ..... *R. chrysops.*

*R. lineatus* (Bloch). Striped bass. Length up to 1,500 mm.; weight up to 90 lbs.; head 3.25 to 3.5; depth 3.5 to 4; color olivaceous, silvery, with 7 to 8 narrow longitudinal stripes on the middle and upper portions of the body; 2 patches of teeth at the base of the tongue; rays of dorsal fins IX-I, 12; anal III, 11; scales 8-67-11: Atlantic Ocean from New Brunswick to the Gulf of Mexico, entering the rivers in the spring to spawn; occasionally in Lake Ontario; abundant.

*R. chrysops* (Rafinesque). White bass. Length 450 mm.; head 3.5; depth 2.5; back with a high arch; color silvery, with about 6 narrow dark longitudinal stripes on the upper and middle portions of the body; 1 patch of teeth at the base of the tongue; rays of dorsal fins IX-I, 14; anal III, 11 or 12; scales 10-55 to 65-15: Great Lakes region to Manitoba; southward in Mississippi Valley to Arkansas; in deeper waters; abundant.

**2. Morone** Mitchill. Body elliptical, compressed; spinous and soft-rayed portions of dorsal fins confluent; lower jaw slightly projecting; base of tongue without teeth: 2 species.

**Key to the Species of Morone**

$a_1$ In the lower Mississippi Valley ..... *M. interrupta.*
$a_2$ In the Atlantic and its tributary rivers ..... *M. americana.*

*M. interrupta* Gill. Yellow bass. Length 450 mm.; head 3; depth 2.6; color brassy yellow, with 7 distinct black longitudinal

lines, those below the lateral line interrupted posteriorly; rays of dorsal fins IX-I, 12; anal III, 9 or 10; scales 7-50 to 54-11: lower Mississippi Valley, northward to the Ohio River and to central Indiana and Illinois; westward to the Kansas River; common towards the south in large rivers and lakes.

*M. americana* (Gmelin). White perch. Length 400 mm.; head 3; depth 3; color dark olivaceous; sides silvery, usually with faint paler streaks; rays of dorsal fins IX-I, 12; anal III, 8 or 9; scales 8-50 to 55-12: Atlantic Ocean; abundant in brackish pools and in river mouths, also often in fresh water ponds, from Nova Scotia to South Carolina.

FIG. 62.—*Aplodinotus grunniens* (*from Jordan & Evermann*).

**Family 6. Sciænidæ.**—The drums. Body compressed, more or less elongate; back elevated; scales ctenoid; lateral line continuous and extending on to the tail fin; premaxillaries protractile; dorsal fin single, deeply notched or separated into two fins; air bladder large and often complex, enabling the fish to make drumming sounds; no teeth on the palatines, vomer, pterygoids or tongue; branchiostegals 7: about 30 genera and 150 species, mostly in warm seas; a few in fresh water, 1 in the United States.

**Aplodinotus** Rafinesque. With the characters of the family: 1 species.

*A. grunniens* Raf. Sheephead (Fig. 62). Length up to 1,100 mm.; weight up to 50 lbs.; head 3.3; depth 2.75; color silvery; dusky above; rays of dorsal fins IX-I, 25 to 30; anal II, 7; scales 9-55-13; lower pharyngeals very large, with blunt teeth; head scaly: Great Lakes to Alabama and Texas, between the Alleghenies and the Great Plains; common in large streams and lakes; an inferior food fish in the north, but not in the south.

**Suborder 5. Holconoti.**—The surf fishes. Viviparous fishes with united pharyngeals, an increased number of vertebræ, cycloid scales and many rays in the soft-dorsal and anal fins: 1 family.

**Family Embiotocidæ.**—Body elliptical, compressed; cheeks, opercles and interopercles scaly; lateral line continuous; branchiostegals 5 or 6: 17 genera and about 20 species, all marine but one.

**Hysterocarpus** Gibbons. Body ovate; back elevated; dorsal fin single, the spinous portion very long; anal fin very long: 1 species.

*H. traski* Gibbons. Length 100 mm.; head 3.3; depth 2; color brown above; sides yellowish, with fine dots; throat and belly yellow; rays of dorsal fin XVI to XVIII, 11; anal III, 22: rivers of central California; locally abundant

**Suborder 6. Chromides.**—Lower pharyngeals fully united; nostrils single on each side: 2 families, 1 marine, the other in fresh waters of South and Central America, with one representative in Texas.

**Family Cichlidæ.**—Body elevated; scales usually ctenoid; lateral line incomplete; no pseudobranchiæ: 150 species, in the rivers of tropical America and Africa.

**Heros** Heckel. Body oblong, compressed; dorsal fin continuous; caudal fin somewhat rounded: numerous species.

*H. cyanoguttatus* (Baird & Girard). Length 150 mm.; head 3.25; depth 2.1; color brownish, the body and soft parts of the median fins spotted with blue; rays of dorsal fin XVII, 10; anal VI, 8: southwestern Texas.

**Suborder 7. Loricati.**—The mailed-cheek fishes. Fishes with the third suborbital bone extending across the cheek to or towards the preopercle: 8 families, most of them marine, 1 in fresh water.

**Family Cottidæ.**—Sculpins. Body elongate, tapering backward from the broad head; body not uniformly scaled but either naked or armed with scales, bony plates or spines; lateral line present; ventral fins thoracic; dorsal fins either separate or connected; anal fins without spines; pseudobranchiæ present; air-bladder usually wanting: about 60 genera and 250 species, mostly marine; many species in fresh water.

**Key to the Fresh Water Genera of Cottidæ**

$a_1$ Ventral fins with 4 soft rays..... 1. *Cottus.*
$a_2$ Ventral fins with 3 soft rays.
  $b_1$ No slit behind the gills..... 2. *Uranidea.*
  $b_2$ A small slit behind the gills..... 3. *Triglopsis.*

**1. Cottus** L. Fresh-water sculpins. Body smooth, sometimes with prickles; preopercle with a spine at its angle and usually 2 or 3

spines below it; villiform teeth on the vomer, jaws and sometimes the palatines; gill openings separated by a wide isthmus; pectoral fins large; dorsal fins usually nearly or quite separate: numerous species, in the northern hemisphere.

### Key to the Species of Cottus

$a_1$ Palatine bones with teeth; the two dorsal fins usually very slightly connected at base, or not at all.
  $b_1$ Anal rays 15 to 20.
    $c_1$ Vent midway between tip of snout and base of tail..... *C. asper*
    $c_2$ Vent nearer the tail than the tip of the snout..... *C. gulosus.*
  $b_2$ Anal rays 11 to 13.
    $c_1$ In the far-western States.
      $d_1$ Snout pointed..... *C. rhotheus.*
      $d_2$ Snout blunt.
        $e_1$ Caudal peduncle very slender..... *C. punctulatus.*
        $e_2$ Caudal peduncle deep (dorso-ventrally wide)..... *C. semiscaber.*
    $c_2$ In the eastern and northern States..... *C. ictalops.*
$a_2$ Palatine bones without teeth.
  $b_1$ In the Klamath Lakes region, Oregon..... *C. klamathensis.*
  $b_2$ In the Columbia River basin..... *C. beldingi.*
  $b_3$ In the Colorado River basin..... *C. annæ.*

*C. asper* Richardson. Length 300 mm.; head 3.25; depth 4.5; color grayish olive, mottled and spotted with blackish; prickles coarse and stiff; rays of dorsal fins IX or X, 19 to 21; anal 17 or 18: San Francisco Bay to Vancouver Island; abundant in cold streams.

*C. gulosus* (Girard). Riffle fish. Length 150 mm.; head 3; depth 4.5; color grayish olive, mottled with darker; rays of dorsal fin VIII or IX, 19 to 21; anal 16 to 18: southeastern Oregon; California, from San Francisco Bay southward; very common.

*C. rhotheus* Rosa Smith. Length 100 mm.; head 3; depth 4.5; color dark gray, spotted and mottled; rays of dorsal fins VII or VIII, 16 or 17; anal 11 or 12: Columbia River basin; common.

*C. punctulatus* (Gill). Length 125 mm.; head 3; depth 4.75; color olivaceous, spotted with black and with 5 or 6 dark lateral cross bars; rays of dorsal fins VII or VIII, 17 or 18; anal 11 or 12: head waters of Green River, Wyoming; southeastern Oregon; common.

*C. semiscaber* (Cope). Rocky Mountain bullhead. Length 100 mm.; head 3; depth 4.5; color gray, with inconspicuous cross bars on the sides; rays of dorsal fins VIII, 17 or 18; anal 12 or 13: New Mexico and Wyoming into Montana and Washington; common.

*C. ictalops* (Rafinesque). Miller's thumb (Fig. 63). Length 150 mm.; head 3.3; depth 4 to 6; color olivaceous, barred or speckled with darker; rays of dorsal fins VI to VIII, 16 or 17; anal about 12: middle or northern States from New York to the Dakotas; southward along the Alleghenies to Alabama; very common in clear brooks and lakes; very variable.

*C. klamathensis* Gilbert. Length 130 mm.; head 3; depth 4 to 4.3; color brownish olive, much blotched with darker; rays of dorsal fin VII, 19; anal 14; the 2 dorsal fins broadly joined; lateral line very incomplete; preopercle with a single short spine: Klamath Lakes, Oregon; very common.

*C. beldingi* Eigenmann. Length 100 mm.; head 4; depth 5; color mottled black and white, with 6 blackish cross bars on the back, the first across the head behind the eyes; rays of dorsal fin VI to VIII, 15 to

FIG. 63.—*Cottus ictalops* (*from Fishes of Illinois*).

18; anal 11 to 13: abundant east of the Cascades, Columbia River basin.

*C. annæ* Jordan & Sparks. Length 75 mm.; head 3.5; depth 5; color light gray, somewhat mottled; rays of dorsal fin VII or VIII, 17 or 18; anal 12; mouth very small; preopercle with 1 blunt spine and no others: Colorado River basin; common.

**2. Uranidea** DeKay. Similar to *Cottus*, but differing from it in the small size of the ventral fins which contain 1 concealed spine and 3 soft rays; skin smooth; palatines without teeth: 9 species, in cold streams in the northern States, from New England to the Pacific.

*U. bendirei* (Bean). Length 75 mm.; color dark brown, lighter on the throat and belly; rays of dorsal fins VIII, 16; anal, 12; palatines with teeth; preopercle with 4 spines: Columbia basin in Oregon and Idaho.

*U. tenuis* Evermann & Meek. Length 75 mm.; head 3.8; depth 7; color dark above and pale beneath; under side of head speckled; rays of dorsal fins VI-I, 17; anal 15; body very slender: Klamath Lakes, Oregon.

*U. gracilis* (Heckel). Head 3.5; depth 5; color olivaceous, mottled; upper edge of spinous dorsal fin red in life; rays of dorsal fins VIII, 16; anal 12: New England and New York; common.

**3. Triglopsis** Girard. Body and head slender; skin naked; lateral line chain-like; teeth on vomer, but not on palatines; a small distinct slit behind the last gill; preopercular spines 4: 1 species.

*T. thompsoni* Girard. Length 75 mm.; head 3; depth 6; color olivaceous, with dark blotches; eyes very large; rays of dorsal fins VII, 18; anal 15; dorsal fins separate; the soft dorsal and the anal fins very large: deep waters of the Great Lakes; not common.

**Suborder 8. Gobioidei.**—Ventral fins thoracic, I, 4 or I, 5; pseudobranchiæ present; dorsal fins separate or united; dorsal spines few and weak; soft-dorsal and anal long; caudal fin rounded: 2 families of marine fishes, with a few fresh water representatives.

**Family Gobiidæ.**—Gobies. Body mostly elongate, naked or covered with ctenoid scales; ventral fins close together, usually united; no lateral line; no pyloric cæca: 600 species, a very few in fresh water; shore fishes in tropical regions.

**Dormitator** Gill. Body short, robust; head broad, blunt and flat; mouth small, oblique; scales large; fins large: 1 species.

*D. maculatus* (Bloch). Length 600 mm.; head 3.2; depth 3; color dark gray or brown with lighter spots; dorsal fins separate and with parallel black bands; rays of dorsal fins VII-I, 8 or 9; anal I, 9 or 10; scales 33: both coasts of America from North Carolina and Cape St. Lucas to Brazil, in fresh and brackish water.

**Suborder 9. Anacanthini.**—Dorsal and anal fins very long and without spines; ventral fins jugular, without spines; no pseudobranchiæ: 3 families, all marine, with 1 species in fresh water.

**Family Gadidæ.**—The codfishes. Body elongate; scales cycloid; mouth large, terminal; pyloric cæca numerous: 140 species, in northern seas; 1 species in fresh water.

**Lota** Cuvier. Body long and low, depressed in front, compressed behind; anterior nostrils each with a short barbel; chin with a long barbel; 2 dorsal fins, the first short, the second very long; caudal fin rounded: 1 species.

*L. maculosa* (LeSueur). Burbot; lawyer; ling. Length 600 mm.; head 4.5; depth 5.5; color dark olive marbled with blackish; rays of dorsal fins 13-76; anal 68: lakes and sluggish streams, from New England to the upper Missouri; northward to the Arctic and Berings Strait; southward to the Ohio; common towards the north.

**Suborder 10. Heterostomata.**—The flat-fish. Bones of the head unsymmetrical, both eyes being on the same side; anus near the head; pseudobranchiæ present; dorsal fin extending the length of the body; anal fin similar but shorter; body much compressed, the side without an eye being usually colorless and kept lowermost; young individuals symmetrical: 2 families, all marine, one species in fresh water.

**Family Soleidæ.**—The soles. Body oval in outline; cranium much twisted, the mouth very small; teeth rudimentary or wanting: 150 species.

**Achirus** Lacépède. Eyes and color on right side; scales well developed, ctenoid; eyes separated by a bony ridge; pectoral fins minute or wanting: numerous species.

*A. fasciatus* Lac. Length 200 mm.; head 4; depth 1.8; color dusky olive, mottled with 8 dark, narrow, vertical stripes; rays of dorsal fin 50 to 55; anal 37 to 46; scales 66 to 75; origin of dorsal fin at tip of snout: Cape Ann to Texas, ascending rivers; common.

## CLASS 2. AMPHIBIANS (AMPHIBIA; BATRACHIA)

The amphibians are cold-blooded vertebrates which, so far as the American species are concerned, are devoid of scales and other special integumental coverings and have no claws or nails on their digits. Their eggs are usually deposited in the water or in wet places where the young animals live, breathing by means of integumental gills, while they undergo a metamorphosis which transforms them into the more or less terrestrial adults.

Amphibians occupy a place in the zoological system intermediate between fishes and reptiles, being physiologically like the former when young and the latter when adult. They resemble fishes and differ from the higher vertebrates chiefly in the possession of gill-slits and exclusively aquatic respiration during a part or all of their lives, by the absence of allantois and amnion, the possession of a single ventral aorta through which the blood leaves the heart, and of ten instead of twelve cranial nerves. They differ from fishes and resemble the higher vertebrates chiefly in the absence of dermal scales, in the possession of pentadactyle limbs, of lungs, and a more or less terrestrial life-habit, and in the reduction of the bones of the head.

**History.**—It has apparently been a difficult matter to fix the position of the amphibians in the zoological system. Linnæus originated the term *Amphibia*, but included in it also reptiles, and many ganoid and cyclostomate fishes. This tendency to group amphibians and reptiles together existed also among subsequent authors for almost a hundred years, although Blainville as early as 1816 clearly indicated the proper relations of the two classes; the common group was called by some authors the *Reptilia* and by others the *Amphibia*, the possession of scales being the distinctive feature which marked the former group. Milne-Edwards, Cope and Huxley were among the first authors to see matters more clearly, and to speak definitely of *Amphibia* and *Reptilia* as two distinct and equivalent classes. In recent times the systematic study of amphibians has attracted relatively few authors. G. A. and E. G. Boulenger have been among the most influential. In this country the most important have been Spencer F. Baird and Edward D. Cope, each of whom devoted a life-time to the study of the group. Cope's *Batrachia of North America* is perhaps the most comprehensive and fundamental single work treating it.

**Number and Distribution.**—About 1,400 species of amphibians are known, of which 150 species are *Caudata*, or salamanders, and 1,200 species are *Salientia*, or frogs and toads. The burrowing, limbless *Apoda*, which are confined to tropical America, Africa and India, number about 50 species. The *Caudata* occupy principally the temperate and subtropical portions of Europe, Asia and America, penetrating only into the extreme northern parts of Africa, and not occurring at all in Australia and the east Indian archipelago. The *Salientia* inhabit the entire world, except the polar regions and the smaller oceanic islands.

The amphibian fauna of the United States is very rich, a feature in which it parallels the distribution of other animal groups with a similar habitat, namely, fresh water fish and fresh water mollusks. A comparison of the number of species of amphibians inhabiting New York State and Germany or Great Britain will illustrate the statement: in Germany the *Caudata* are represented by 4 species and in New York by 15; Great Britain possesses 3 species of *Salientia*, while New York has 13.

**Key to the Orders of Amphibia in the United States**

$a_1$ Body elongate, with a tail which persists throughout life; salamanders..... 1. *Caudata.*

$a_2$ Body of adult short and tailless; young with a long tail which disappears in the metamorphosis; frogs and toads..... 2. *Salientia.*

**Order 1. Caudata** (*Urodela*).—Salamanders. Amphibians with an elongate body and usually two pairs of weak limbs. The vertebræ are numerous and are accompanied by ribs. The skin is without scales and is very glandular, the secretion in some species being poisonous. The eyes are small and the eye-lids are not present in the lower forms. The ear is entirely internal, as in fishes, there being no tympanum or tympanic cavity. The body muscles have a conspicuously segmental arrangement, like those of fishes, the vertical grooves which separate the muscle segments of the trunk being usually easily seen on the outside of the body, and called the *costal grooves* (Fig. 72). Teeth may be present on the maxillaries, premaxillaries, vomers, pterygoids, parasphenoid and mandibles. The eggs are usually deposited in the water and the larvæ, when born, are provided with three pairs of external gills, which are expansions of the outer integument and not homologous to the gills of fishes. These gills disappear during the metamorphosis, except in *Necturus*, *Typhlomolge* and *Siren*. In some of the *Plethodontidæ* the greater part of the larval stage is spent in the egg and the young are terrestrial from the time of birth and without gills.

The lower *Caudata* are aquatic animals throughout life, the higher ones are mostly terrestrial as adults, but must still live in moist places.

The 150 species of *Caudata* are grouped in 3 suborders and are found mostly in the temperate parts of the northern hemisphere; about 99 species occur in North America and 69 species in the United States.

**On the Identification of Caudate Amphibia.**—The descriptions of salmanders in this book apply to adult animals. The most important descriptive features are the shape and appearance of the body and its color, the length of the body in millimeters, including the tail, the length

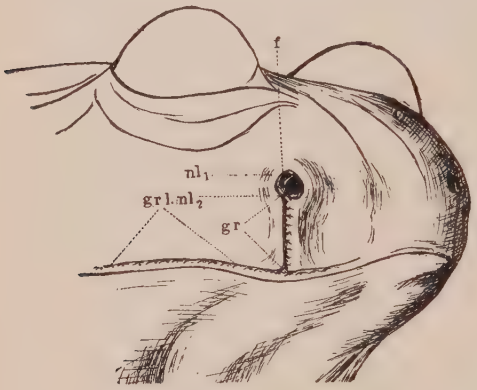



FIG. 64

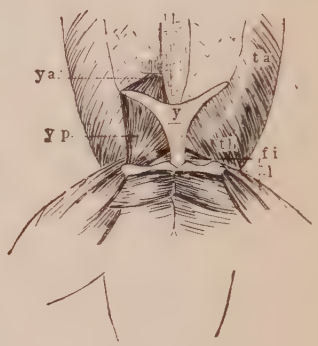



FIG. 65

FIG. 64.—The naso-labial groove of *Desmognathus fusca: f*, crescentic fold which closes the nostril when the head is submerged; *gr*, naso-labial groove which drains the nostril when the head emerges from the water; *grl*, labial groove; *nl*, orifices of glands (*from Whipple*).

FIG. 65.—The ypsiloid cartilage of *Triturus viridescens: l*, pubis; *y*, ypsiloid cartilage; the other letters refer to muscles (*from Whipple*).

of the tail, the number of costal grooves between the fore and hind limbs, the number of digits, and the position of the teeth, especially those of the vomers and parasphenoid. The *naso-labial groove*, a glandular groove passing from the nostril to the lip (Fig. 64), and the plantar tubercles, which are elevations on the palms and soles, are also often important. Several features of the internal structure are important in a full analysis of the various groups, although a knowledge of them is not usually necessary for the identification of species: these are the shape of the vertebræ, the form and condition of the cranial bones and cartilages, the presence or absence of the lungs and of the cartilage which may lie in the ventral body wall just anterior to the pubis and is called the *ypsiloid cartilage* (Fig. 65).

### Key to the Suborders of the Caudata

$a_1$ Two pairs of legs present.
  $b_1$ Adults with gills and gill-slits throughout life.....1. *Proteida.*
  $b_2$ Adults without gills (except in Typhlomolge).....2. *Mutabilia.*
$a_2$ But one pair of legs present.....3. *Meantes.*

**Suborder 1. Proteida.**—Body elongate, with 2 pairs of weak legs; 3 pairs of gills and 2 pairs of gill slits persistent throughout life; vertebræ amphicœlous; maxillaries absent; eyelids absent; both jaws with teeth: 1 family.

**Family Proteidæ.**—With the characters of the suborder: 2 genera, the species of one of which, *Proteus*, are found in caves in southern Europe, and are blind and colorless.

**Necturus** Rafinesque. Toes 4 on all four feet; eyes very small: 2 species.

*N. maculosus* (Raf.). Mudpuppy; waterdog. Body subcylindrical; head flattened, with a fold of skin across the throat; tail compressed; color of adult dark brown above, lighter beneath, more or less spotted and splotched with darker brown and black; young striped; length 360 mm.; tail 110 mm.; extreme length 600 mm.: valleys of the Great Lakes and the Mississippi north of the Gulf States, as well as the upper waters of many streams flowing into the Atlantic and the Gulf; Lake Champlain and the upper Hudson; Manitoba; southward into northern Alabama and Arkansas; often very common in rivers and lakes.

*N. punctatus* (Gibbes). Head short, elevated; length 170 mm.; tail 50 mm.; color pale, unspotted: North and South Carolina, in rivers of the coastal plain.

**Suborder 2. Mutabilia.**—Salamanders and newts. Body elongate, without gills in the adult, except in certain cave species; vertebræ amphicœlous or opisthocœlous; carpus and tarsus cartilaginous or bony; eyelids absent or present; maxillaries present; both jaws with teeth: 5 families.

### Key to the Families of Mutabilia

$a_1$ Adult with a pair of gill slits (but without gills).
  $b_1$ Body eel-shaped; legs very small and rudimentary.....1. *Amphiumidæ.*
  $b_2$ Body salamander-shaped; legs not rudimentary.....2. *Cryptobranchidæ.*
$a_2$ Adult without gill slits.
  $b_1$ No naso-labial groove present (Fig. 64); parasphenoid without teeth.
    $c_1$ Costal grooves present (Fig. 72); vomerine teeth in a transverse series (Fig. 69).....3. *Ambystomidæ.*

$c_2$ Costal grooves absent; vomerine teeth in longitudinal series (Fig. 71) ..... 4. *Salamandridæ.*

$b_2$ Naso-labial groove present (Fig. 64); parasphenoid teeth present (Fig. 80); costal grooves present; lungs absent. 5. *Plethodontidæ.*

**Family 1. Amphiumidæ.**—Body serpentine in form, with about 100 vertebræ; a pair of small gill slits; vertebræ amphicœlous; carpus and tarsus cartilaginous; no eyelids; vomerine teeth prominent, forming an arched series parallel with those of the jaw; 2 pairs of weak legs; tail short, compressed: 1 genus.

**Amphiuma** Garden. With the characters of the family: 2 species.

*A. means* Gard. Congo snake. Body dark brown above, light below; length 886 mm.; tail 182 mm.; 2 toes on each foot; costal grooves about 60: Virginia to Florida and westward to Louisiana; northward to Arkansas; in swamps, sometimes on the land; eggs about 150 in number and with a diameter of 9 mm.

*A. tridactylum* Cuvier. Similar to *A. means* but more distinctly bicolored and larger and with 3 toes on each foot: northern Florida to southern Louisiana, and up the Mississippi Valley to Missouri.

**Family 2. Cryptobranchidæ.**—Giant salamanders. Body stout and of large size; a pair of small gill-slits usually persistent; vertebræ amphicœlous; carpus and tarsus cartilaginous; no eyelids; vomerine teeth form an arched series parallel with the jaws: 2 genera, one of which, *Megalobatrachus*, is found in China and Japan and contains but one species, *M. maximus* (Schlegel), which grows to a length of 5 feet and is the largest salamander.

**Cryptobranchus** F. S. Leuckart. Fore legs with 4 and hind legs with 5 toes each; gill slits always persistent: 1 species.

*C. alleganiensis* (Daudin). Hellbender. Body dark brown in color; head and trunk depressed, tail compressed; prominent lateral fold present; length 480 mm.; tail 160 mm.: western New York and central Pennsylvania to Georgia and Louisiana; westward to Iowa; aquatic; often common.

**Family 3. Ambystomidæ.**—Body of medium size; a transverse (gular) fold of skin just in front of the fore legs; digits 4-5; a transverse series of teeth, more or less interrupted, on the hinder margin of the vomers; tongue thick, free in front; vertebræ amphicœlous; carpus and tarsus ossified; eyelids present; lungs and ypsiloid cartilage present: 3 genera in the United States; habitat usually terrestrial.

**Key to the United States Genera of Ambystomidæ**

$a_1$ Lungs rudimentary; ypsiloid cartilage aborted; on Pacific slope. 1. *Rhyacotriton.*

$a_2$ Lungs and ypsiloid cartilage (Fig. 65) well developed.

$b_1$ Tail dorsally thin and flattened.....2. *Dicamptodon.*
$b_2$ Tail dorsally thick and glandular.....3. *Ambystoma.*

**1. Rhyacotriton** Dunn. Lungs very small; ypsiloid cartilage aborted; nasal bones absent: 1 species.

*R. olympicus* Gaige. Color black above; length 125 mm.: Olympic Mountains, Washington, in mountain streams.

**2. Dicamptodon** Strauch. Lungs and ypsiloid cartilage normal: nasal bones present: 2 species.

*D. ensatus* (Eschscholtz) (*Chondrotus tenebrosus* Baird & Girard). Body very large and massive; legs stout; color reddish brown, mottled above; length 250 mm.; tail 100 mm.; costal grooves 12, obscure: coastal region of Pacific slope, from central California to British Columbia.

*D. aterrimus* (Cope). Body stout; color black above, plumbeous beneath; length 160 mm.; costal grooves 12: Montana.

**3. Ambystoma** Tschudi. Lungs and ypsiloid cartilage well developed; premaxillary fontanelle small or wanting; nasals present: about 18 species, all American except *A. persimilis* Gray of Siam; about 12 species in the United States. These salamanders can float in water without swimming movements, because of their lungs.

**Key to the United States Species of Ambystoma**

$a_1$ Species east of the Rockies.
  $b_1$ Costal grooves 10 to 12; vomerine teeth in 1, 3 or 4 patches, running across the mouth behind the nares (Fig. 69).
    $c_1$ Two plantar tubercles (Fig. 68) present.
      $d_1$ Costal grooves 10.....*A. talpoideum.*
      $d_2$ Costal grooves 12.....*A. trigrinum.*
    $c_2$ One plantar tubercle present or none.
      $d_1$ Costal grooves 11.
        $e_1$ Body with black and white bars.....*A. opacum.*
        $e_2$ Body black with 2 rows of yellow spots.....*A. maculatum.*
      $d_2$ Costal grooves 12; toes very long.....*A. jeffersonianum.*
  $b_2$ Costal grooves 14; teeth in 2 patches not extending behind the nares (Fig. 70).
    $c_1$ Definite color markings in form of cross bars.
      $d_1$ Body black with narrow white cross lines.....*A. cingulatum.*
      $d_2$ Body dark brown with broad yellow cross bars.....*A. annulatum.*
    $c_2$ No definite cross bars present.....*A. microstomum.*
$a_2$ Species in the Rockies and far-west.
  $b_1$ Four phalanges in the fourth toe of hind foot.
    $c_1$ Body mottled with black and yellow; no dorsal stripe.*A. tigrinum.*
    $c_2$ A light dorsal stripe present.....*A. macrodactylum.*
  $b_2$ Three phalanges in the fourth toe of hind foot.

$c_1$ Body without spots.....*A. paroticum.*
$c_2$ Body spotted.....*A. decorticatum.*

*A. talpoideum* (Holbrook). Mole salamander. Body short, stout, depressed, gray or dark brown in color dotted with gray; head very broad; length 90 mm.; tail 37 mm.; costal grooves 10; vomerine teeth in 3 patches: southern States from North Carolina to Louisiana and up the Mississippi Valley to Illinois.

*A. opacum* (Gravenhorst). Marbled salamander (Fig. 66). Body thick, cylindrical, black above with about 14 grayish bars which may be confluent; costal grooves 11; length 95 mm.; tail 38 mm.; plantar tubercles indistinct; vomerine teeth in 3 patches: eastern States from central Massachusetts and New York to Florida; westward to Missouri and Texas; in relatively dry and often sandy locations, under stones and logs.

FIG. 66.—Roof of mouth of *Ambystoma opacum*, showing vomerine teeth (*from Cope*).

FIG. 67.—*Ambystoma maculatum* (*from Fowler*).

*A. maculatum* (Shaw) (*A. punctatum* L.). Spotted salamander (Fig. 67). Body stout; color black above, with a series of round yellow spots on the side, about 3 being on the head, 8 or 9 on the tail and 8 or 9 on the trunk; length 160 mm.; tail 77 mm.; costal grooves 11; skin pitted with numerous minute pores which exude a milky secretion: eastern and central America from Nova Scotia to Georgia; westward to Wisconsin, Nebraska and Texas.

*A. tigrinum* (Green). Tiger salamander; axylotl (Fig. 68). Body thick and massive, dark brown in color, with many large rounded or irregular yellow spots which may be confluent; length 250 mm.; tail 125 mm.; costal grooves 12; vomerine teeth in one long transverse band: America east of the Rockies; Mexico; common, especially

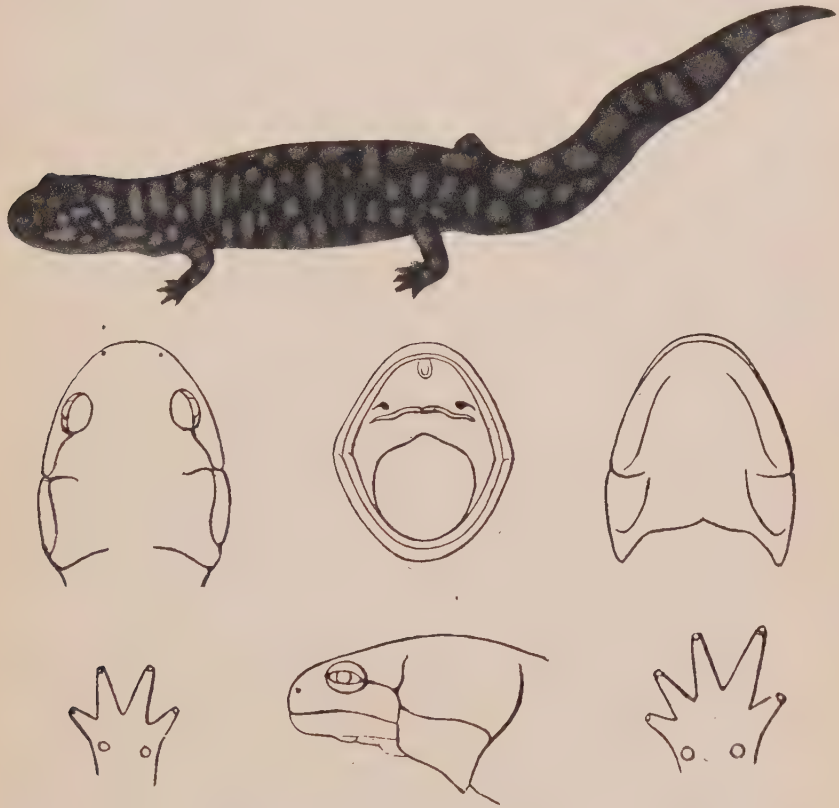


FIG. 68.—(Above) *Ambystoma tigrinum* (*from Fowler*): (below) head, inside of mouth and inner surface of feet of same (*from Cope*).

in the west. The larva sometimes becomes sexually mature and breeds, although it still has gills and lives in the water: it is then called an axylotl, and was formerly supposed to be a distinct species and given the name *Siredon pisciformis* Dumeril.

*A. jeffersonianum* (Green) (Fig. 69). Body long and slender, brownish or blackish in color, with pale dots which may be wanting; digits very long; no plantar tubercles, or a single indistinct one; length 150 mm.; tail 75 mm.; costal grooves 12: northeastern States and Canada; northward to Hudson Bay; southward and westward to Tennessee, southern Illinois and Arkansas; common northward.

*A. cingulatum* Cope. Body slender, black in color, speckled, with gray underneath, and a series of narrow gray rings encircling it from the eyes to the tip of the tail; head elongate; length 85 mm.; costal grooves 14: South Carolina to northern Florida.

*A. microstomum* Cope (*A. texanum* Matthes) (Fig. 70). Body elongate, slender, brown or blackish in color, with numerous grayish spots on the sides; limbs weak; digits very long; length 150 mm.; tail 65 mm.; costal grooves 14: central States, Ohio to Texas; often common.

*A. paroticum* Baird. Body stout and reddish brown or blackish in color, without spots; length 180 mm.; tail 102 mm.; costal grooves 11; no plantar tubercles; eyes very large;

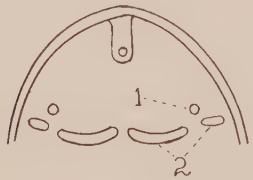



FIG. 69.—Roof of mouth of *Ambystoma jeffersonianum:* 1, inner nares; 2, vomerine teeth (*from Cope*).

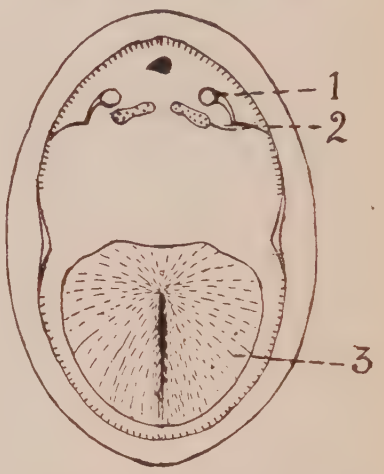



FIG. 70.—Inside the mouth of *Ambystoma microstomum:* 1, inner nares; 2, vomerine teeth; 3, tongue (*from Hay*).

vomerine teeth in 4 small patches, forming a transverse series: California to Vancouver Island.

*A. macrodactylum* Baird (*A. stejnegeri* Ruthven). Body elongate and slender, brownish in color, with a broad lighter dorsal stripe; length 100 mm.; tail 50 mm.; costal grooves 12; vomerine teeth in 3 or 4 transverse patches; digits very long: northern California to British Columbia and eastward into Montana and Iowa.

*A. annulatum* Cope. Body slender; tail very long; color dark brown above, with about 15 light cross bands, very light beneath; length 186 mm.; tail 94 mm.; costal grooves 13; tail with 31 grooves; vomerine teeth in 2 patches: Arkansas; rare.

*A. decorticatum* Cope. Body brown in color, closely set with whitish spots of irregular forms and sizes; length 175 mm.; tail 84 mm.; costal grooves 11; vomerine teeth form a single transverse patch; no plantar tubercles: British Columbian coastal region.

**Family 4. Salamandridæ.**—Body of medium size; teeth on the maxillaries and premaxillaries; vomerine teeth in 2 longitudinal series,

converging anteriorly; vertebræ opisthocœlous; carpus and tarsus ossified; lungs and ypsiloid cartilage present; no naso-labial groove: about 10 genera, all in the old world, one of which is represented in America.

**Triturus** Rafinesque (*Diemyctylus* Raf.). Newts. Tongue attached by nearly its whole lower surface; digits 4-5: about 12 species in Europe, Asia and America, 4 species in the United States. These salamanders can float in water without swimming movements, because of their lungs.

### Key to the American Species of Triturus

$a_1$ Species east of the Rockies.
  $b_1$ Red markings on the side of the body.
    $c_1$ Circular, black-edged red spots on the sides..... *T. viridescens.*
    $c_2$ A continuous or broken red line edged with black, on the side..... *T. dorsalis.*
  $b_2$ No red markings present; on the Gulf coastal plain..... *T. meridionalis.*
$a_2$ Species west of the Rockies..... *T. torosus.*

*T. viridescens* Raf. Spotted salamander; newt (Fig. 71). Body of adult elongate; tail with a prominent keel above and below; color olive green above, yellowish beneath, sprinkled everywhere with black dots except on the belly, and with a row of 2 to 6 or more round red black-edged spots on the side of the trunk; length 90 mm.; tail 44 mm.: eastern and central States and Canada, from Hudson Bay to Florida and Texas; westward to Wisconsin and Oklahoma; common. The adult animals are aquatic, living in ponds and streams containing vegetation. The eggs are few in number and are attached separately to vegetation. There are two larval stages, in the first of which the animal is aquatic, with gills and the color of the adult, and in the second it is terrestrial, without gills and bright red in color and smaller in size, but is spotted like the adult and without a keeled tail. The first stage

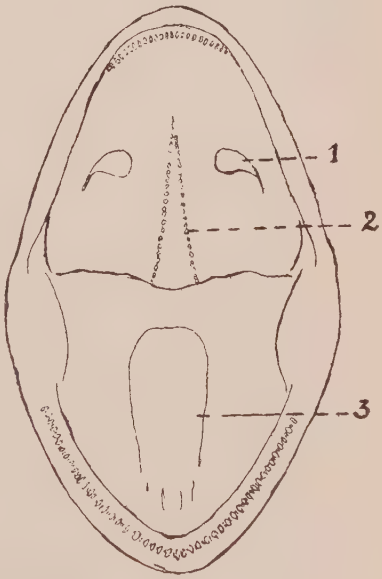



FIG. 71.—Inside the mouth of *Triturus viridescens:* 1, inner nares; 2, vomerine teeth; 3, tongue (*from Hay*).

lasts 3 or 4 months; the second lasts 2 or 3 years, and at the end of it the animal again becomes aquatic.

*T. dorsalis* (Harlan). Similar to *T. viridescens*, but with the red spots forming a continuous or a broken line: coastal plain of North and South Carolina.

*T. meridionalis* (Cope). Similar to *T. viridescens*, except that instead of the red spots there are black ones on both trunk and tail: southern Georgia to Mexico, on the coastal plain.

*T. torosus* (Eschscholtz). Body rather stout; tail long, with a wide keel above and below; color brown above and yellow beneath; length 170 mm.; tail 92 mm.: Pacific slope, from Alaska to Lower California, in ponds and streams; no terrestrial form present.

**Family 5. Plethodontidæ.**—Body of medium or small size and without gills or gill slits in the adult state, except in certain cave dwelling species; a transverse (gular) fold just in front of the fore legs; parasphenoid and vomerine teeth present (Fig. 72); costal grooves 11 to 21; veretbræ amphicœlous or opisthocœlous; carpus and tarsus cartilaginous; lungs absent; ypsiloid cartilage absent; naso-labial groove present (Fig. 64): about 16 genera and 50 species, all American but two, which occur in Italy. These salamanders cannot float in water without swimming motions, and are, with few exceptions, terrestrial animals, living in shaded, moist localities near or in small streams. In several genera the larvæ are also terrestrial, losing their gills before they hatch, or very soon after, and never entering the water; the larvæ of *Desmognathus*, however, make for the water, in which they live about a year.

**Key to the Genera of Plethodontidæ**

$a_1$ Blind, white, cave-dwelling salamanders.
  $b_1$ Adult without gills; in Missouri..... 9. *Typhlotriton.*
  $b_2$ Adult with gills; in Texas..... 10. *Typhlomolge.*
$a_2$ Salamanders which are not blind or white in color.
  $b_1$ Tongue attached at its anterior margin.
    $c_1$ Hind foot with 5 toes.
      $d_1$ Teeth not confined to the front of the jaw.
        $e_1$ With a light line running from the eye to the angle of the mouth..... 1. *Desmognathus.*
        $e_2$ No such line present.
          $f_1$ Vomerine teeth absent..... 2. *Leurognathus.*
          $f_2$ Vomerine teeth present.
            $g_1$ Vomerine teeth continuous with the parasphenoid teeth..... 8. *Stereochilus.*

$g_2$ Vomerine teeth separated from the parasphenoid teeth.
$h_1$ Palm without plantar tubercles.... 3. *Plethodon.*
$h_2$ Palm with 2 plantar tubercles..... 5. *Ensatina.*
$d_2$ Front teeth alone present and projecting from the closed mouth..... 6. *Aneides.*
$c_2$ Hind foot with 4 toes.
$d_1$ In the eastern States..... 4. *Hemidactylium.*
$d_2$ On the Pacific slope..... 7. *Batrachoseps.*
$b_2$ Tongue free at its anterior margin, being attached by a central pedicle (Fig. 77).
$c_1$ Toes not webbed.
$d_1$ With a light line running from the eye to the nostril..... 11. *Gyrinophilus.*
$d_2$ No such line present.
$e_1$ Vomerine teeth continuous with parasphenoid teeth; color red..... 12. *Pseudotriton.*
$e_2$ Vomerine teeth separate from the parasphenoid teeth (Fig. 80)..... 13. *Eurycea.*
$c_2$ Toes webbed..... 14. *Hydromantes.*

**1. Desmognathus** Baird. Body of medium or small size; tongue attached, except by its lateral margins; premaxillaries united; vertebræ opisthocœlous; vomerine teeth wanting in adult males of some species; a light line from the eye to the angle of the mouth: 5 species.

**Key to the Species of Desmognathus**

$a_1$ Tail keeled above; large species.
$b_1$ Belly mottled.
$c_1$ In States east of the Mississippi..... *D. fusca.*
$c_2$ In Arkansas..... *D. brimleyorum.*
$b_2$ Belly uniformly colored.
$c_1$ Belly black..... *D. quadramaculata.*
$c_2$ Belly light..... *D. monticola.*
$a_2$ Tail cylindrical; small species..... *D. ochrophæa.*

*D. fusca* (Rafinesque) (Fig. 72). Body rather stout, brown above, mottled below; length 115 mm.; tail 58 mm.; costal grooves 14; vomerine teeth not present in mature males; parasphenoid teeth in 2 separated patches: southern Canada to the Gulf; westward to Illinois, Tennessee and Louisiana; common.

*Subspecies of D. fusca*

*D. f. fusca* (Raf.). Belly light; no spots on the sides: southern Canada to central Alabama, Georgia and southeastern Virginia, except in the higher mountains.

*D. f. auriculata* (Holbrook). Belly dark; a row of light spots on the sides: coastal plain of the Atlantic and Gulf from Virginia to the Mississippi.

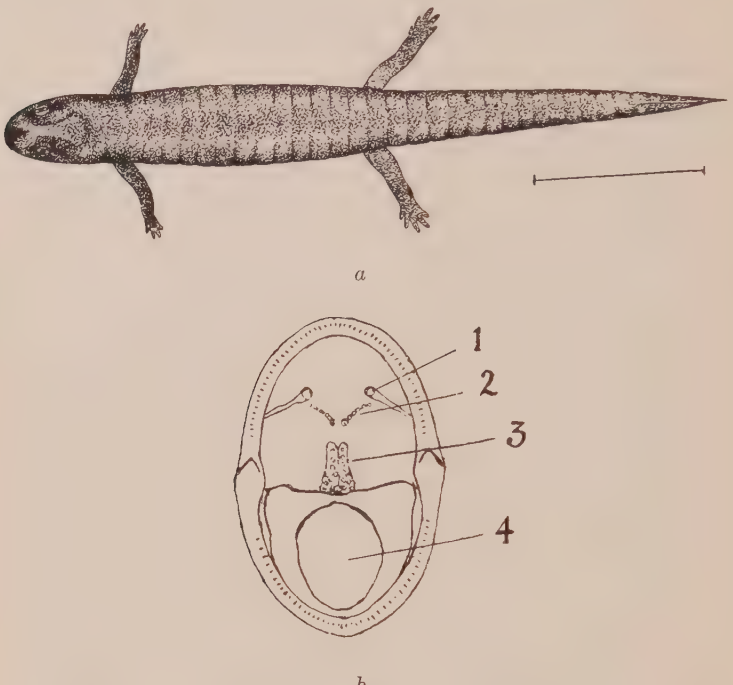



FIG. 72.—*Desmognathus fusca: a*, dorsal aspect (*from Fowler*); *b*, inside of the mouth: 1, inner nares; 2, vomerine teeth; 3, parasphenoid teeth; 4, tongue (*from Hay*).

*D. brimleyorum* Stejneger. Body slender and similar to *D. f. auriculata* in color; belly light; size and teeth similar to *D. f. fusca:* central Arkansas; rare.

FIG. 73.—*Desmognathus monticola* (*from Dunn*).

*D. quadramaculata* (Holbrook). Body large, black above and below; length 175 mm.; tail 82 mm.; costal grooves 12 to 14; parasphenoid

teeth in 2 patches which are confluent anteriorly; vomerine teeth always present: Virginia to Georgia, in the mountains; the most aquatic of the genus.

*D. monticola* Dunn (Fig. 73). Body large, uniformly colored, more or less mottled, with a light belly; tail long; length 135 mm.; tail 71 mm.; costal grooves 13 or 14; vomerine teeth always present; parasphenoid teeth in 2 patches, confluent anteriorly: Virginia and West Virginia to Georgia; in the mountains; common.

*D. ochrophæa* Cope. Body small; tail without keel; color variable, with a very dark, broad lateral band; length 94 mm.; tail 46 mm.; costal grooves 14; vomerine teeth absent in adult male; parasphenoid patches separated: New York to Georgia; habits terrestrial.

*Subspecies of D. ochrophæa*

*D. o. ochrophæa* Cope. Belly very light; back light in young and black in old specimens: New York to Maryland.

*D. o. carolinensis* Dunn. Belly dark; a tubercle at the anterior angle of the eye: West Virginia to Georgia; in the mountains.

**2. Leurognathus** Moore. Body of large size; internal nares very inconspicuous and twice as far apart as the nostrils; vertebræ opisthocœlous; vomerine teeth absent: 1 species.

*L. marmorata* Moore. Body 128 mm. long; tail 53 mm.; parasphenoid teeth in 2 patches which touch anteriorly; costal grooves 13; tail keeled; color brownish above; belly black in old specimens: North Carolina mountains; rare; aquatic.

**3. Plethodon** Tschudi. Body slender and elongate; tongue attached except at its lateral margins; vertebræ amphicœlous; premaxillaries separate; parasphenoid and vomerine teeth present, the 2 parasphenoid patches in contact throughout; toes 4-5: about 12 species, all American. Both adults and larvæ are largely terrestrial, living in damp places, under stones and logs, the larvæ in some species losing their gills while still in the egg, and never entering the water. The eggs are sometimes carried in the mouth of the female.

**Key to the Species of Plethodon**

$a_1$ Species occurring east of the Pacific slope.
  $b_1$ Color not uniformly plumbeous, and with spots or stripes.
    $c_1$ With a broad middorsal red stripe.
      $d_1$ Costal grooves 19 ..... *P. cinereus.*
      $d_2$ Costal grooves 17 ..... *P. dorsalis.*
    $c_2$ No such stripe present; costal grooves 14.
      $d_1$ Back blackish, dotted with white ..... *P. glutinosus.*

$d_2$ Back red or chestnut.....*P. yonahlossee.*
$b_2$ Color uniformiy plumbeous.
$c_1$ Body without color markings.
$d_1$ Belly mottled; costal grooves 19.....*P. cinereus.*
$d_2$ Belly plain.
$e_1$ Costal grooves 14.....*P. metcalfi.*
$e_2$ Costal grooves 17.....*P. wehrlei.*
$c_2$ Body with color markings.
$d_1$ Legs red.....*P. shermani.*
$d_2$ With a yellow stripe from eye to gular fold.....*P. jordani.*
$a_2$ Species occurring on the Pacific slope.
$b_1$ Digits not webbed.
$c_1$ Costal grooves 14.....*P. intermedius.*
$c_2$ Costal grooves 16.....*P. elongatus.*
$b_2$ Digits webbed; costal grooves 12 or 13.....*P. vandykei.*

*P. cinereus* (Green). Red-backed salamander; dusky salamander (Fig. 74). Body very slender, cylindrical and elongate, and dark brown

FIG. 74.—*Plethodon cinereus* (*from Fowler*).

or dark gray in color with a broad, light reddish stripe running down the back, which is sometimes wanting, there being thus two distinct color phases; under parts mottled; length 90 mm.; tail 45 mm.; costal grooves 19; vomerine teeth not extending laterally beyond the inner nares:

FIG. 75.—The roof of the mouth of *Plethodon glutinosus* (*from Dunn*).

Canada and States east of the Mississippi; Missouri and Arkansas; very common towards the north; both larvæ and adults terrestrial.

*P. dorsalis* Cope. Similar to *P. cinereus* but with 17 costal grooves, and a zigzag dorsal stripe: southern portions of Ohio, Indiana and Illinois to Alabama.

*P. glutinosus* (Green) (Fig. 75). Body rather stout, depressed, blackish in color with whitish blotches and dots; length 138 mm.;

tail 67 mm.; costal grooves 14; vomerine teeth extending laterally beyond the internal nares: eastern and central States and New York; westward to Wisconsin and central Texas; southward to the Gulf States; terrestrial; common in upland districts.

*P. yonahlossee* Dunn. Similar to *P. glutinosus*, but with a chestnut red dorsal coloration and with paired red spots: mountains of North Carolina and Virginia.

*P. metcalfi* Brimley. Similar to *P. glutinosus*, but slenderer; color plain plumbeous, paler beneath; length 108 mm.; tail 53 mm.; costal grooves 14; vomerine teeth in 2 short curved transverse rows: mountains of North Carolina; often very common.

*P. wehrlei* Fowler & Dunn. Similar to *P. metcalfi;* dorsal surface with paired spots; costal grooves 17; toes webbed: central and western Pennsylvania and West Virginia.

*P. shermani* Stejneger. Similar to *P. metcalfi*, but with red legs; length 104 mm.; tail 56 mm.; costal grooves 14: western North Carolina.

*P. jordani* Blatchley. Similar to *P. metcalfi;* color black, with a red or yellow stripe on the side of the head between the eye and the gular fold; legs sometimes dotted with red; costal grooves 14: mountains of Tennessee and North Carolina.

*P. intermedius* Baird. Similar to *P. cinereus* in color; length 90 mm.; tail 38 mm.; costal grooves 14: California to Vancouver Island.

*P. elongatus* Van Denburgh. Similar to *P. intermedius*, but with 16 costal grooves; length 117 mm.; tail 58 mm.: northern California.

*P. vandykei* Van Denburgh. Similar to *P. intermedius*, but stouter and with 13 or 14 costal grooves; back clay-colored, dotted with black; lower surfaces black; length 116 mm.; tail 56 mm.; toes partly webbed: western Washington.

**4. Hemidactylium** Tschudi. Like *Plethodon*, but with 4 toes on the hind foot: 1 species.

*H. scutatum* (Schlegel). Body small, cylindrical, dark chestnut above, white beneath with large black spots; tail with a basal constriction; length 80 mm.; tail 46 mm.; costal grooves 14: eastern and central States and Canada; northward into Massachusetts; westward into Michigan, Illinois and Arkansas; southward into the Gulf States; terrestrial; locally common.

**5. Ensatina** Gray. Similar to *Plethodon*, but with a basal constriction of the tail and with 2 plantar tubercles on the palm: 3 species, 1 (*E. platensis*) in Uruguay and Argentina.

*E. eschscholtzi* Gray. Body depressed, brown or orange in color; tail short and slender; limbs long; length 115 mm.; tail 50 mm.; costal

grooves 11; parasphenoid patches of teeth diverging posteriorly, confluent anteriorly: Pacific slope from Los Angeles to Puget Sound.

*E. croceater* (Cope). Body large, black in color with yellow dorsal spots; bright orange beneath; costal grooves 13; length 145 mm.; tail 87 mm.: southern California; Sierra Nevadas.

**6. Aneides** Baird. Similar to *Plethodon*, but differs in that there is but one premaxillary and the maxillary and mandibular teeth are few in number and confined to the anterior portion of the arch; vomerine teeth on a ridge between the internal nares: 4 species.

**Key to the Species of Aneides**

$a_1$ On the Pacific slope.
  $b_1$ Hinder portion of tail rounded or oval.
    $c_1$ Color light brown, with yellow spots..... *A. lugubris.*
    $c_2$ Color black above..... *A. ferreus.*
  $b_2$ Hinder portion of tail strongly compressed..... *A. iecanus.*
$a_2$ In the southeastern States..... *A. æneus.*

*A. lugubris* (Hallowell). Body light yellow above with yellowish spots and yellow beneath; length 75 mm.; tail 35 mm.; snout very prominent; eyes bulging; anterior teeth projecting from the closed mouth; costal grooves 13: California; common; adults and larvæ terrestrial, the latter being without functional gills.

*A. ferreus* (Cope). Body slender, black above, with gray on the sides and brown beneath; length 90 mm.; tail 37 mm.; costal grooves 14: northern California to British Columbia.

*A. iecanus* (Cope). Body robust, black in color, with minute light specks; length 53 mm.; costal grooves 13; parasphenoid teeth in a single patch: northern California.

*A. æneus* (Cope & Packard). Body rather stout; color dark, mottled coppery and black; length 118 mm.; tail 66 mm.; costal grooves 14: Virginia and West Virginia to Georgia; rare.

**7. Batrachoseps** Bonaparte. . . Similar to *Plethodon*, but with 4 toes on the hind foot and but one premaxillary: 4 species, all on the Pacific slope, 1 species in Alaska.

**Key to the Species of Batrachoseps**

$a_1$ Costal grooves 19..... *B. attenuatus.*
$a_2$ Costal grooves 18.
  $b_1$ Color of dorsal surface dark brown..... *B. pacificus.*
  $b_2$ Color of dorsal surface light gray..... *B. major.*

*B. attenuatus* (Eschscholtz). Body slender, with very weak legs and a long tail; color brown above and below but darker on the belly and the

sides; length 111 mm.; tail 64 mm.; costal grooves 19; leg spanning 3 costal folds; parasphenoid and vomerine teeth in 1 patch each: Pacific slope west of the Coast Range from Oregon to Lower California; very common.

*B. pacificus* (Cope). Body elongate, brown above, yellowish beneath; length 70 mm.; tail 37 mm.; costal grooves 18; leg spanning 6 costal folds; inner digits of both pairs of legs rudimentary: islands off Californian coast.

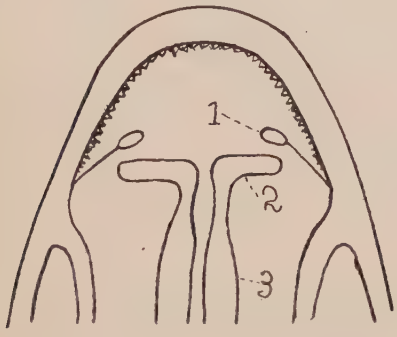



FIG. 76.—Roof of mouth of *Gyrinophilus porphyriticus:* 1, inner nares; 2, vomerine teeth; 3, parasphenoid teeth (*from Cope*).

FIG. 77.—Head of *Pseudotriton*, showing the tongue (*after Hurter*).

*B. major* Camp. Body large, pale in color, light yellowish beneath; costal folds 18; length 134 mm.; tail 74 mm.: southern California; terrestrial.

**8. Stereochilus** Cope. Tongue attached at its anterior margin; vomerine teeth confluent with parasphenoid teeth; 1 premaxillary: 1 species.

*S. marginatus* (Hallowell). Body slender, yellowish brown in color, with numerous brown lines along the sides; belly yellow, specked with brown; length 79 mm.; tail 35 mm.; costal grooves 17; tail compressed: Dismal Swamp to Georgia; aquatic.

**9. Typhlotriton** Stejneger. Body of medium size; tongue attached anteriorly; eyes concealed under the skin: 1 species.

*T. spelæus* Stej. Body white, 120 mm. long; costal grooves 16: in caves in Missouri.

**10. Typhlomolge** Stejneger. Body elongate, with very long legs and persistent gills; eyes concealed under the skin: 1 species.

*T. rathbuni* Stej. Body white, and with the general structure of a sexually mature *Eurycea* larva; length 102 mm.; length of legs 20 mm.: in wells in San Marcos, Texas.

**11. Gyrinophilus** Cope. Body elongate; tongue free anteriorly; premaxillaries distinct; vomerine teeth continuous with the parasphenoid: 2 species.

*G. porphyriticus* (Green) (Fig. 76). Body large and purplish brown in color, blotched with gray; belly whitish; length 163 mm.; tail 60 mm.; costal grooves 15; eye connected with nostril by a conspicuous light colored ridge: eastern States; westward to Kentucky; common; aquatic.

*G. danielsi* (Blatchley). Body elongate; color light chocolate brown above, with widely scattered dots of black which are wanting on the hinder two-thirds of the tail, light brown beneath; length 160 mm.; tail 65 mm.; costal grooves 16: North Carolina to Georgia; Tennessee.

**12. Pseudotriton** Baird (*Spelerpes* Rafinesque). Body elongate, red in color; tail short and compressed; tongue

*a*

FIG. 78.—*Pseudotriton ruber* (*from Fowler*): *a*, root of mouth (*from Dunn*).

free all round, being attached by a slender pedicle only (Fig. 77); but 1 premaxillary; vomerine teeth continuous with the parasphenoid (Fig. 78): 2 species.

**Key to the Species of Pseudotriton**

$a_1$ A few scattered black spots present.....*P. montanus.*
$a_2$ Many black spots close together.....*P. ruber.*

*P. montanus* Baird. Body elongate, cylindrical, brownish salmon in color, with a few circular spots; under parts pale salmon; length 140 mm.; tail 62 mm.; the 2 patches of parasphenoid teeth in contact anteriorly: Pennsylvania to the Gulf.

*Subspecies of P. montanus*

*P. m. montanus* Baird. Costal grooves 17: Pennsylvania and Kentucky to Georgia.

*P. m. flavissimus* Hallowell. Costal grooves 16 to 18: Gulf States, from Georgia to Louisiana.

*P. ruber* (Sonnini). Red salamander (Fig. 78). Body rather stout and dark salmon red in color, with numerous black spots, very large specimens often showing more black than red; length 140 mm.; tail 53 mm.; costal grooves 16: eastern States from Maine to Florida; westward to Louisiana, Illinois and Wisconsin; very common.

*Subspecies of P. ruber*

*P. r. ruber* (Sonnini). Spots of adult running together; chin blackish: eastern States; New York and Indiana to northern Georgia and Mississippi.

*P. r. schencki* (Brimley). Spots of adult separate; chin black: mountains of North Carolina.

*P. r. nitidus* Dunn. Spots of adult separate; no black on the chin or on the hinder half of the tail; length 97 mm.; tail 36 mm.: mountains of Virginia and North Carolina.

**13. Eurycea** Rafinesque. (*Spelerpes* Rafinesque.) Body elongate, mostly yellow or orange in color; tail long and compressed; vomerine teeth separate from the parasphenoid (Fig. 80); tongue free all round, being attached by a slender pedicle only (Fig. 77): 7 species.

**Key to the Species of Eurycea**

$a_1$ Digits on hind leg 5.
  $b_1$ Color yellow.
    $c_1$ Tail with longitudinal stripes.
      $d_1$ Tail with 2 lateral and no dorsal stripes..... *E. bislineata.*
      $d_2$ Tail with 2 lateral and 1 dorsal stripe..... *E. guttolineata.*
    $c_2$ Tail barred..... *E. longicauda.*
  $b_2$ Color orange; tail spotted..... *E. lucifuga.*
  $b_3$ Color black or brown.
    $c_1$ Costal grooves 13; color black..... *E. melanopleura.*
    $c_2$ Costal grooves 20; color brown..... *E. multiplicata.*
$a_2$ Digits on hind leg 4..... *E. quadridigitata.*

*E. bislineata* (Green) (Fig. 79). Body small, yellow above and below, with a dark line along each side of the back; length 72 mm.; tail 40 mm.; costal grooves 14 or 15; digits very long: northern New England to Florida; westward to Lake Superior and Louisiana; very common.

*Subspecies of E. bislineata*

*E. b. bislineata* (Green). Costal grooves 15: northern New England to Indiana; southward to Virginia and Tennessee.

*E. b. cirrigera* (Green). Sides dusky, with white dots below the lateral band; costal grooves 14; upper lip of male with cirri: North Carolina to Louisiana.

*E. b. wilderæ* Dunn. Black lateral line broken or absent on the hinder half of tail; male with cirri; costal grooves 15: mountains of Virginia and North Carolina.

*E. guttolineata* (Holbrook). Body similar to *E. bislineata*, but with a mottled belly and 3 dark dorsal longitudinal lines; length 130 mm.; tail 75 mm.; costal grooves 13: Virginia to Georgia; westward to Louisiana.

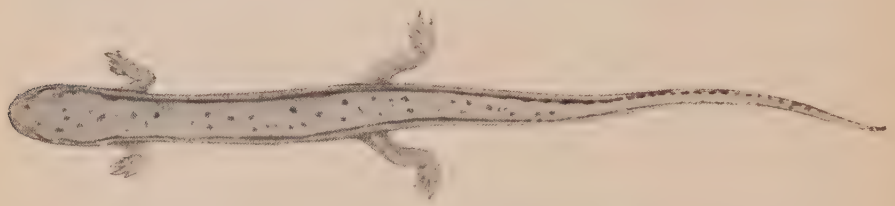


FIG. 79.—*Eurycea bislineata (from Dunn).*

*E. longicauda* (Green). Body slender, with a very long tail and bright yellow or reddish in color, with small black spots on the back and sides which form bars on the tail, and unspotted underneath; length 130 mm.; tail 80 mm.; costal grooves 13: Pennsylvania to Tennessee; westward to Missouri.

*E. lucifuga* Rafinesque (*E. maculicauda* Cope) (Fig. 80). Body slender, elongate, orange in color densely spotted with black; legs very long; length 152 mm.; tail 90 mm.: West Virginia to Missouri; northward into Indiana and Illinois; often in caves.

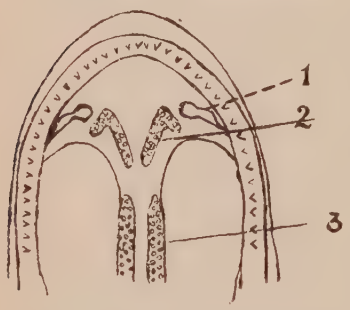



FIG. 80.—The roof of the mouth of *Eurycea lucifuga:* 1, inner nares; 2, vomerine teeth; 3, parasphenoid teeth *(from Hay).*

*E. quadridigitata* (Holbrook). Dwarf salamander. Body small, yellowish above, with a dark line running along each side of the back; length 82 mm.; tail 47 mm.; costal grooves 15; 4 toes on each foot: North Carolina to Florida; westward to Texas.

*E. melanopleura* (Cope). Body slender; tail strongly compressed; sides black in color, with sparse white spots; a middorsal light line; length 148 mm.; tail 83 mm.; costal grooves 13: Missouri and Arkansas.

*E. multiplicata* (Cope). Body small, brown in color, paler below; length 80 mm.; tail 170 mm.; costal grooves 20: Arkansas, Missouri and Kansas to New Mexico.

**Hydromantes** Gistel. Toes webbed; tongue free all round; 2 premaxillaries present; parasphenoid patches separate: 3 species, 2 in Italy.

*H. platycephalus* (Camp). Body elongate; tail cylindrical, rather short; color dark chocolate, mottled with black; length 106 mm.; tail 35 mm.; costal folds 12: Yosemite National Park, California.

## ON THE IDENTIFICATION OF THE LARVÆ OF THE PLETHODONTIDÆ

Aquatic larvæ are known to occur in the genera *Desmognathus*, *Leurognathus*, *Typhlotriton*, *Typhlomolge* (a permanent larva), *Grinophilus*, *Pseudotriton* and *Eurycea:* these larval forms have all been identified in the eastern and middle western States. They may be distinguished from the larvæ of the *Ambystomidæ* and *Salamandridæ* which inhabit the same region by the presence of a dorsal fin on the body of the larva in these two families. This fin is universally absent in the larvæ of the *Plethodontidæ*.

### Key to the Larvæ of the Plethodontidæ

$a_1$ Blind, white larvæ; costal grooves 12; legs very long..... *Typhlomolge.*

$a_2$ Eyes functional; body pigmented; legs normal.

$b_1$ Gills short, glistening white; legs very stout.

$c_1$ Definite color-pattern of light dorsal spots. *Desmognathus fusca.*

$c_2$ No definite color-pattern.

$d_1$ Chin and throat light; eyes smaller, lateral..... *Desmognathus quadramaculata.*

$d_2$ Chin and throat pigmented; eyes larger, more dorsal..... *Leurognathus marmorata.*

$b_2$ Gills longer, not glistening white; legs slimmer.

$c_1$ Back and sides the same color.

$d_1$ Sides irregularly streaked..... *Stereochilus.*

$d_2$ Sides not so streaked.

$e_1$ Chin and throat pigmented; head longer..... *Grynophilus.*

$e_2$ Chin and throat not pigmented; head shorter.

$f_1$ Costal grooves 16..... *Pseudotriton ruber.*

$f_2$ Costal grooves 17..... *Pseudotriton montanus.*

$f_3$ Costal grooves 18..... *Typhlotriton.*

$c_2$ Back lighter than the sides..... *Eurycea.*

$d_1$ Digits on hind leg 5.

$e_1$ No sharp demarcation between the lighter back and the darker sides; a gray band on the sides; costal grooves 14-15..... *Eurycea lucifuga.*

$e_2$ A sharp and uninterrupted demarcation between the lighter back

and the darker sides; sides black; costal grooves 13-14.
$f_1$ A definite stripe on side.....*Eurycea guttolineata.*
$f_2$ No definite stripe on side.....*Eurycea longicauda.*
*Eurycea melanopleura.*
$e_3$ A sharp but broken demarcation between the lighter back and the darker sides.
$f_1$ Costal grooves 14-15.....*Eurycea bislineata.*
$f_2$ Costal grooves 20.....*Eurycea multiplicata.*
$d_2$ Digits on hind leg 4.....*Eurycea quadridigitata.*

**Suborder 3. Meantes.** Three pairs of gills persistent throughout life; maxillaries wanting; vomers wanting, vertebræ amphicœlous: 1 family.

**Family 1. Sirenidæ.**—Body very elongate, eel-shaped; hind legs and pelvis wanting; carpus cartilaginous; 3 pairs of external gills which atrophy in the young and grow again in the adult; 1 or 3 pairs of gill slits; eyes very small; 2 patches of teeth on parasphenoid; premaxillaries and mandibles toothless and with horny sheaths: 2 genera and species.

**Key to the Genera of Sirenidæ**

$a_1$ Leg with 4 toes.....1. *Siren.*
$a_2$ Leg with 3 toes.....2. *Pseudobranchus.*

**1. Siren** L. Four toes on each leg; 3 pairs of gill-slits present: 1 species.

*S. lacertina* L. Mud eel. Body dark gray above, lighter beneath, more or less cylindrical in shape; head flattened; snout truncate; tail compressed; lateral grooves 31 to 37; length 700 mm.; tail 240 mm.; fore leg 38 mm.: south Atlantic and Gulf States, from District of Columbia and central North Carolina to the Rio Grande, and northwards in the valley of the Mississippi to Alton, Illinois and Lafayette, Indiana; in swamps; often common.

**2. Pseudobranchus** Gray. Three toes on each leg; 1 pair of gill slits: 1 species.

*P. striatus* (LeConte). Body light with dark stripes; snout pointed; mouth very small; length 150 mm.; tail 65 mm.; fore leg 4 mm.; gills often covered by a fold of skin: South Carolina to Florida; in swamps; not common.

**Order 2. Salientia** (*Anura*).—Frogs and toads. Amphibians with two pairs of well developed legs and without a tail in the adult stage, but with a long tail and weak legs during some stage of the larval life

(American forms). The body is short and compact, there being in most cases nine vertebræ, and either no ribs or three very short ones; in addition to the vertebræ is the urostyle, a bone which is homologous to the caudal vertebræ and extends backward from the pelvic girdle. The hind legs are usually long and muscular. The head is generally very large; the eyes are large and protruding, and the eyelids well developed; the tympanum is flush with the surface of the skin. Just behind the eye and behind and above the tympanum in the toads is a conspicuous raised glandular area called the *parotoid gland* (Fig. 81). The general surface of the skin is glandular, and is either smooth or tubercular and warty. The color is often bright, and metachrosis is very general.

FIG. 81.—Upper surface of head of *Bufo americanus:* 1, cranial crests; 2, tympanum; 3, parotoid glands (*after Surface*).

The male, in most forms, has a large vocal sack which opens into the mouth by one or two slits in its floor, by means of which it can produce a call which is often very loud; they can, however, croak without the aid of their vocal sacks, and some species do not have them. The tongue is absent in the tropical family *Pipidæ*, but in most of the others it is well developed and attached in front, the hinder end being free so that it can be thrown forward; it is in this manner that the animal captures the insects and other small animals on which it feeds. The eggs are usually laid in the water and the tadpoles which emerge from them have external integumental gills and a swimming tail, but no legs. In the metamorphosis which follows the gills and tail are absorbed, the legs and lungs develop, the head and mouth change their form and relative size, and the animal becomes adult and fitted for a terrestrial life.

About 1,200 species of *Salientia* are known, which occur in all the geographical regions of the earth, about 60 species being in the United States, grouped in 6 families.

**On the Identification of the Salientia.**—The descriptions of frogs and toads in this book apply to both adults and larvæ, and inasmuch as the animals in these two stages of development differ radically in form and appearance, the descriptions of the two stages are given separately.

**1. The Adult.**—There is a general uniformity in the shape of the body of the various species of frogs and toads, and the most important descriptive features are the following; the length in millimeters and color of the body, the size and shape of the head, the length of the hind legs, the character of the digits, the number of which is four in the fore foot and five in the hind, the character of the skin, whether it is smooth, tubercular or warty, the presence and character of the parotoid gland, the tympanum and the teeth. For a complete analysis of the main group several internal structures are important—the ribs, vertebræ, sacrum and pectoral girdle.

**Key to the Families of the Salientia**

$a_1$ Ribs present.....5. *Discoglossidæ.*
$a_2$ Ribs absent.
  $b_1$ Pupil of eye vertical; parotoid glands present.....2. *Pelobatidæ.*
  $b_2$ Pupil of eye horizontal or round.
    $c_1$ Parotoid glands present (Fig. 81) toads.....3. *Bufonidæ.*
    $c_2$ Parotoid glands absent.
      $d_1$ Expanded adhesive disks at ends of digits; tree toads (Figs. 88 and 89).....4. *Hylidæ.*
      $d_2$ No such disks present.
        $e_1$ Upper jaw with teeth; frogs.....5. *Ranidæ.*
        $e_2$ Upper jaw without teeth.....6. *Brevicipitidæ.*

**Family 1. Discoglossidæ.**—Ribs present; vertebræ opisthocœl; tongue with but little movement; larvæ with a midventral spiracle: 5 genera, 1 in New Zealand, 3 in the Palearctic region and 1 in western America.

**Ascaphus** Stejneger. Tympanum and Eustachian tube wanting; tongue free behind; sternum cartilaginous; maxillary and vomerine teeth present; parotoid gland well developed: 1 species.

*A. truei* Stej. Color reddish brown or slate gray above, with a few blackish markings, and whitish beneath; a black streak from the nostril through the eye and along the lower border of the parotoid gland;

length 40 mm.; length of hind leg 59 mm.: western Washington, central Oregon and northern California.

**Family 2. Pelobatidæ.**—Spadefoot toads. Body of medium size; head broad and short; eyes prominent; maxillary teeth present; heel with a prominent spur which is used in digging: 5 genera and 70 species, in the Nearctic and Palearctic regions; 1 genus in the United States.

**Scaphiopus** Holbrook. Body toad-like; tympanum present; hind feet partly webbed; vomerine teeth present: 4 species, all in the United States.

**Key to the Species of Scaphiopus**

$a_1$ In the eastern and Gulf States; parotoid glands and tympanum distinct.....*S. holbrooki.*

$a_2$ In the western States; parotoid glands and tympanum indistinct.

$b_1$ In the Pacific States and eastward to Texas and Dakota.....*S. hammondi.*

$b_2$ In Texas and along the Mexican border.....*S. couchi.*

*S. hurteri.*

*S. holbrooki* (Harlan). Common spadefoot (Fig. 82). Body either smooth or covered with small tubercles and brown, yellowish or greenish in color, sometimes with a curved yellow line extending back from the shoulder; belly dirty white; iris golden; length 68 mm.; hind leg 76 mm.: eastern States from Massachusetts to Florida; Gulf States and Texas, and northward into Arkansas; common, but rarely seen because it spends the day in a hole in the ground which it digs with its hind feet, emerging in the nighttime to feed.

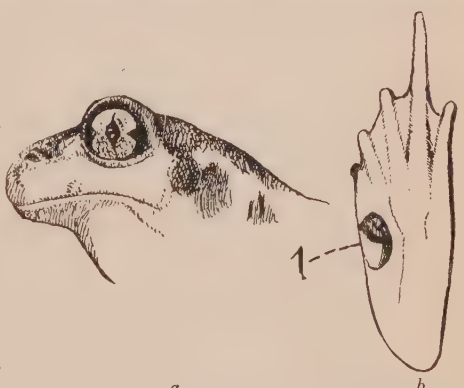



FIG. 82.—*a*, Left side of the head of the spadefoot toad. *b*, Hind foot of spadefoot: 1, spur (*from Surface*).

*S. hammondi* Baird. Body brown or gray in color, often with several irregular dorsal stripes of lighter color; tubercles with red; throat of male black; length 60 mm.; hind leg 70 mm.: western America from the Pacific eastward into Texas and Dakota.

*S. couchi* Baird. Body greenish or brownish in color, mottled with lighter; belly whitish; dorsal surface with black tubercles, which are sometimes yellow on the hinder parts of the back and legs; length 60 mm.; hind leg 60 mm.: Texas to Arizona.

*S. hurteri* Strecker. Body pale greenish in color, with a yellowish line on each side running back from the orbit; head short; snout very blunt; length 67 mm.: Louisiana, Texas and westwards.

**Family 3. Bufonidæ.**—Toads. Body heavy and awkward; legs short; skin covered with prominent warts and protuberances; parotoid glands prominent; toes 4-5; pectoral girdle arciferous (coracoids and precoracoids overlapping midventrally); presacral vertebræ 8: about 100 species, in all parts of the world; 3 genera in the United States.

**Key to the Genera of the Bufonidæ**

$a_1$ Hind toes webbed.....1. *Bufo.*
$a_2$ Hind toes not webbed.
  $b_1$ Vomerine teeth present.....2. *Eleutherodactylus.*
  $b_2$ Vomerine teeth absent.....3. *Syrrhophus.*

**1. Bufo** Laurenti.—Pupil horizontal; a pair of prominent longitudinal ridges called the *cranial crests* lie between the eyes, which pass back to or along the parotoid glands (Fig. 81); prominent plantar tubercles often present on the digits; eggs laid in a long chord of jelly which is usually deposited on the bottom of some shallow pool: nearly 100 species; 14 in the United States.

**Key to the United States Species of Bufo**

$a_1$ In the States east of the Mississippi.
  $b_1$ In the northeastern States.
    $c_1$ Profile of snout sloping; back with a single wart to a color spot; belly spotted.....*B. americanus.*
    $c_2$ Profile of snout abrupt; back with more than one wart to a color spot; belly usually unspotted.....*B. fowleri.*
  $b_2$ In the southern States.
    $c_1$ Cranial crests very prominent (Fig. 85).....*B. terrestris.*
    $c_2$ Cranial crests inconspicuous.....*B. quercicus.*
$a_2$ In the States west of the Mississippi.
  $b_1$ In the central western States.
    $c_1$ Belly spotted.
      $d_1$ Cranial crests divergent (Fig. 81).....*B. americanus.*
      $d_2$ Cranial crests parallel.....*B. hemiophrys.*
    $c_2$ Belly unspotted.....*B. woodhousi.*
  $b_2$ In the southwestern States.
    $c_1$ Cranial crests absent.
      $d_1$ Parotoid glands small, and oval or round.
        $e_1$ Plantar tubercles small.....*B. punctatus.*
        $e_2$ Plantar tubercles large, with cutting edges.....*B. compactilis.*
      $d_2$ Parotoid glands large and long.....*B. debilis.*
    $c_2$ Cranial crests present.

$d_1$ Cranial crests sharp-edged and high.....*B. valliceps.*
$d_2$ Cranial crests thick, confluent between the nostrils.....*B. cognatus.*
$d_3$ Cranial crests curved around the eyes.....*B. alvarius.*
$b_3$ On the Pacific slope.
$c_1$ With a light middorsal line; skin rough.....*B. boreas.*
$c_2$ Without a light middorsal line; skin very smooth.....*B. canorus.*

*B. americanus* Holbrook. Common toad (Figs. 81 and 83). Body heavy and squat and variable in color, being usually gray or yellowish brown, more or less mottled or spotted; throat of male black; under parts white, spotted; parotoids elongate and reniform; cranial crests

FIG. 83.—Under surface of *Bufo americanus (from Dickerson)*.

divergent; length 70 mm.; hind leg 85 mm.; female much larger: North America east of the Rockies; northward to Hudson Bay and Great Bear Lake.

*B. fowleri* Garman. Common toad (Fig. 84). Body rather slender, greenish or yellowish gray in color, spotted or striped with brown; under parts white; throat of male black; parotoids narrow and not reniform;

cranial crests parallel: length 75 mm.; central New England to Georgia; westward to Michigan.

*B. terrestris* Bonnaterre (Fig. 85). Color dusky, with a pale middorsal line and an irregular row of yellowish spots on the flank; belly yellowish white; length 70 mm.; cranial crests prominent, each ending in a knob: North Carolina to Florida and westward to the Mississippi.

FIG. 84—Under surface of *Bufo fowleri* (*from Dickerson*).

*B. quercicus* Holb. Body small, brown in color, with a light middorsal line on each side of which are 3 or 4 pairs of black blotches; underneath white; length 27 mm.; parotoids long and oval: North Carolina to Florida; the smallest species.

*B. hemiophrys* Cope. Color brown, with a yellowish middorsal line, on each side of which are 2 or 3 rows of brown spots; cranial crests parallel; belly spotted; length 60 mm.: North Dakota and Manitoba.

*B. woodhousei* Girard (Fig. 86). Color brown, with a pale middorsal line and 3 pairs of brown spots; belly yellow; length 90 mm.; head short, with thickened cranial crests posteriorly: Texas to Kansas and Montana; westward to Nevada and eastern California.

*B. punctatus* Baird & Girard. Body small and slender; color light brown above and yellowish white beneath; length 52 mm.; parotoid gland small and round: western Texas to southern California.

*B. compactilis* Wiegmann. Color greenish brown; belly greenish or yellowish; length 72 mm.: New Mexico and Arizona.

*B. debilis* Gir. Similar to *B. punctatus* but with very large parotoid glands, which are elongate and not round; legs with black cross bands:

FIG. 85.—Upper surface of head of *Bufo terrestris* (*from Cope*).

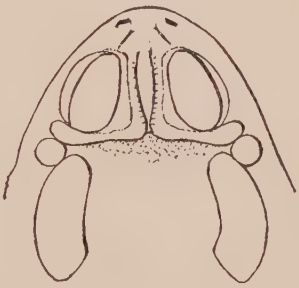


FIG. 86.—Upper surface of head of *Bufo woodhousei* (*from Cope*).

Texas to California; northward into Colorado; southward into Mexico; rather common.

*B. valliceps* Wieg. Color chestnut brown above, with a dark cross band behind the orbits and a dark lateral band; legs cross barred; length 85 mm.: Louisiana and Texas.

*B. cognatus* Say. Body large, dusky brown in color, with a yellowish middorsal line from which project irregular lateral line to the right and left, giving the back a blotchy appearance; white underneath; length 85 mm.; parotoid glands short and wide: western plains from Kansas, Nebraska and Texas to southern California.

### *Subspecies of B. cognatus*

*B. c. cognatus* Say. Wyoming to Texas; west to the Rockies.

*B. c. californicus* Camp. Southwestern California.

*B. alvarius* Gir. Color dark green or brown; belly whitish; length 165 mm.; parotoid gland a long oval: southern Arizona and California; very rare.

*B. boreas* B. & G. (Fig. 87). Body very large, either uniformly dusky brown in color with a light middorsal line or with numerous spots on a yellow or green ground; white underneath, spotted with black; length 124 mm.; parotoid round or oval; no cranial crests: Pacific slope from Alaska to Lower California; eastward to Utah; common.

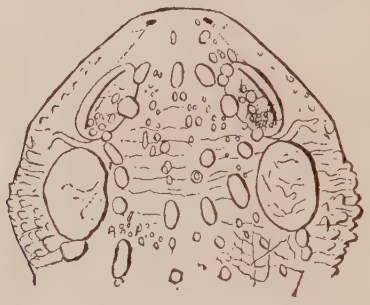


FIG. 87.—Upper surface of head of *Bufo boreas* (*from Cope*).

*Subspecies of B. boreas*

*B. b. boreas* B. & G. Colors dark; web extending to tip of toes: northern California to Alaska.

*B. b. halophilus* B. & G. Body small, slender; color light brown above; web deeply notched, 3 phalanges of fourth toe being free: central California to Lower California.

*B. canorus* Camp. Coloration dimorphic, the female being irregularly blotched and the male specked with black; length 69 mm.; hind leg 82 mm.; parotoids very large and circular; no cranial crests: Yosemite National Park, California, at elevations above 7,000 feet.

**2. Eleutherodactylus** Duméril & Bibron. Vomerine teeth present; body relatively slim; skin smooth or tubercular but not warty; digits not webbed; terminal phalanges with a transverse limb which supports dermal disk: 2 species.

*E. latrans* (Cope). Skin smooth; color brownish gray, with large brown spots; grayish white beneath; length 94 mm.; hind leg 115 mm.; pupil horizontal: San Antonio, Texas.

*E. ricordii* (D. & B.). Skin slightly tubercular: Florida.

**3. Syrrhophus** Cope. Like *Eleutherodactylus*, but without vomerine teeth: several species.

*S. marnocki* Cope. Color purplish brown, spotted; length 38 mm.; hind leg 45 mm.: San Antonio, Texas.

**Family 4. Hylidæ.**—Tree toads; tree frogs. Small *Salientia* which live in trees, bushes or in dense foliage on the ground and return to the

water only in the spring time to breed; maxillary and vomerine teeth present; no parotoid glands; digits expanded at their tips to form glandular disks, the sticky secretion of which assists the animal in climbing; front toes sometimes slightly webbed, hind toes usually fully webbed; eggs of American species laid in small masses in the water: about 190 species, most of which are in the Neotropic region; 18 species in the United States, which often show a remarkable metachrosis.

**Key to the United States Genera of Hylidæ**

$a_1$ Finger and toe disks conspicuous (Fig. 88).....1. *Hyla.*
$a_2$ Finger and toe disks very small (Fig. 89).
  $b_1$ Hind toes fully webbed.....2. *Acris.*
  $b_2$ Hind toes slightly webbed.....3. *Pseudacris.*

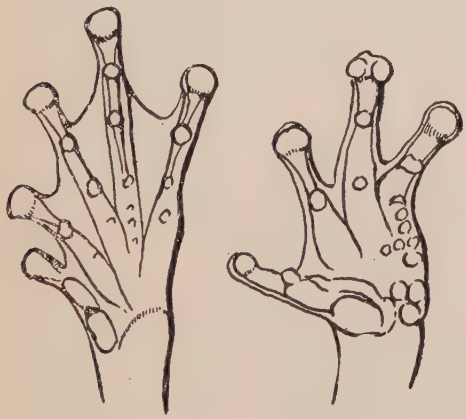


FIG. 88.—Hind and fore foot of *Hyla versicolor (from Surface).*

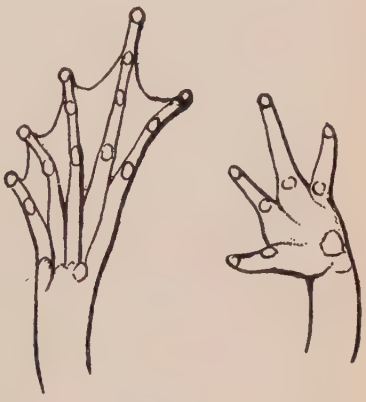


FIG. 89.—Hind and fore foot of *Acris gryllus (from Surface).*

1. **Hyla** Laurenti. Hind toes webbed; skin smooth in most species; belly granulated; pupil round or horizontal: about 10 species in the United States.

**Key to the United States Species of Hyla**

$a_1$ In the States east of the Rockies.
  $b_1$ In the eastern and central States north of the Gulf States.
    $c_1$ Fingers somewhat webbed; skin rough, warty.....*H. versicolor.*
    $c_2$ Fingers entirely free of webb; skin smooth.
      $d_1$ Back with an oblique cross-shaped marking.....*H. crucifer.*
      $d_2$ Back plain, without markings, but sometimes with spots.
        $e_1$ Color on the back without a definite lateral margin.
          $f_1$ No light line on side of the slender head.....*H. evittata.*
          $f_2$ A light line on the upper jaw (sometimes indistinct); head stout.....*H. squirella.*

$e_2$ Color on back with a definite lateral margin.
$f_1$ Hinder surface of thigh spotted or blotched.....*H. andersoni.*
$f_2$ Hinder surface of thigh not marked.....*H. cinerea.*
$b_2$ In the Gulf States.
$c_1$ Fingers somewhat webbed.
$d_1$ Skin rough and warty.....*H. versicolor.*
$d_1$ Skin not warty.
$e_1$ Upper surface glandular, pustulate.....*H. gratiosa.*
$e_2$ Upper surface not glandular.....*H. baudini.*
$c_2$ Fingers entirely free of web.
$d_1$ Back of thighs plain in color, with or without spots.
$e_1$ Color on back with a definite lateral margin.....*H. cinerea.*
$e_2$ Color on back without such a margin.....*H. squirella.*
$d_2$ Back of thighs with large color blotches.....*H. femoralis.*
$b_3$ In the extreme southwest.....*H. arenicolor.*
$a_2$ On the Pacific slope.....*H. regilla.*

*H. versicolor* LeConte. Common tree toad (Fig. 88 and 90). Body rather stout, with a rough, warty skin and very variable in color,

FIG. 90.—*Hyla versicolor (from Dickerson).*

varying from white or gray to deep brown or bright green and more or less mottled, with usually an oblique dark band above and a light spot beneath each eye and a large dark irregularly star-shaped patch on the back between the fore legs; length 50 mm.; hind leg 80 mm.: North America, east of Minnesota, Kansas and Texas; northward to southern Canada; southward into the Gulf States.

### *Subspecies of H. versicolor*

*H. v. versicolor* LeC. Southward to the Gulf States and Arkansas.

*H. v. chrysoscelis* Cope. Skin of upper surface perfectly smooth: southern Arkansas to east-central Texas.

*H. crucifer* Wied (*H. pickeringi* Storer). Spring peeper (Fig. 91). Body small and delicate and varying in color from deep brown to yellow, reddish, green or gray, with an oblique cross-shaped mark on the back and usually a V-shaped mark between the eyes; length 28 mm.; hind leg 45 mm.: eastern and central America; northward to New Brunswick; westward to Manitoba; southward to South Carolina and Louisiana; the earliest frog to make its appearance in the spring; usually found on or near the ground.

*H. evittata* Miller. Body brown, yellow, green or bluish in color, without any markings; length 50 mm.: New Jersey to Virginia, in low bushes near the water; rare.

*H. squirella* Latreille. Body small, green or brown in color with or without spots; a dark line runs from the nostril to the eye and a light line along the jaw and under the eye to the shoulder; length 30 mm.: Virginia to Florida; westward to Texas and northward to Indiana.

*H. andersoni* Baird. Body small, unspotted bright green in color edged on the sides of the body by a band of white; gray beneath; length 40 mm.: New Jersey to South Carolina; rare.

FIG. 91.—*Hyla crucifer* (*from Park Museum Bulletin*).

*H. cinerea* (Schneider). Body slender, dark brownish green, bright green or greenish yellow in color, with a conspicuous white or yellowish band along each side; length 45 mm.; legs very long: Virginia to Florida; the Gulf States and up the valley of the Mississippi to Illinois; common.

*H. gratiosa* LeC. Body very large; skin of back granulated or glandular; color green or brown, entire back generally covered with large spots; length 60 mm.: South Carolina to Florida and Mississippi.

*H. baudini* Duméril & Bibron. Body large, very dark brown, green or gray in color, without spots when the shade is light or dark, but otherwise with a broad mark extending from between the eyes to the middle of the back; length 55 mm.: southwestern Texas.

*H. femoralis* Lat. Body small, and brown or gray in color, with a triangular spot between the eyes and a large irregular blotch on the back and also a dark line on each side of the body; length 35 mm.: North Carolina to Florida; the Gulf States; in pine trees.

*H. arenicolor* Cope. Body robust, gray in color with or without two or three rows of round brown spots on the back; length 42 mm.; skin rough; fingers not webbed: southwestern States from Texas and Utah into southern California.

*H. regilla* Baird & Girard. Pacific tree frog. Body small, and gray, green, brown or red in color, with a wide black band from the nostril through the eye to the shoulder; either without markings or with elongated black blotches on the back and a V-shaped spot on the head; length 53 mm.: Pacific slope from Vancouver Island to Cape St. Lucas; ranging from sea level to 10,000 feet elevation; in low bushes, trees, moist places on the ground, and in burrows of animals.

**2. Acris** Duméril & Bibron. Similar to *Hyla*, except that the digital disks are minute; hind toes webbed: 1 species.

FIG. 92.—*Acris gryllus* (*from Park Museum Bulletin*).

*A. gryllus* (LeConte). Cricket frog (Fig. 89 and 92). Body small, with a warty skin and very variable in color, being usually some shade of brown or gray with a black triangular patch between the eyes, the apex of which is directed backwards, and usually 2 or 3 oblique spots on each side of the back; eyes orange; length 25 mm.; hind legs 40 mm.; toes webbed; a fold of skin over the tympanum and one across the breast: eastern and central America; northward to southern New York and Connecticut; westward to Texas and Dakota; a diurnal frog which lives in the grass and near marshy places, but not in trees.

**3. Pseudacris** Fitzinger (*Chorophilus* Baird). Swamp cricket frogs. Similar to *Hyla*, but without webs between the toes or very short ones, and with very small digital disks: 6 species.

**Key to the Species of Pseudacris**

$a_1$ In the eastern and central States.
  $b_1$ Length of leg to the heel equals length of body.....*P. feriarum.*
  $b_2$ Length of leg to heel equals space from eye to anus.....*P. triseriata.*
$a_2$ In the southern States.
  $b_1$ Muzzle rounded in profile.
    $c_1$ Skin warty above.....*P. nigrita*
    $c_2$ Skin smooth above.
      $d_1$ Hind foot not webbed.....*P. occidentalis.*
      $d_2$ Hind foot slightly webbed.....*P. ornata.*
  $b_1$ Muzzle truncate in profile.....*P. ocularis.*

*P. feriarum* (Baird). Body coarsely granulated above and beneath, warty above, greenish brown or gray in color, creamy underneath; back usually with 3 longitudinal stripes; chin black in male; length 25 mm.; hind leg 40 mm.: eastern States; westward to Illinois.

*P. triseriata* (Wied). Body like *P. feriarum*, but with a pointed head and shorter legs; color light ash, usually with 5 or 6 brown stripes; length 25 mm.: central States from the Alleghenies to Arizona and Idaho.

*P. nigrita* (LeConte). Body like *P. feriarum*, but with a narrow, pointed head and long legs; color varying from black to salmon, with 3 dark dorsal stripes or rows of spots; length 30 mm.: South Carolina to Mississippi.

*P. occidentalis* (Baird & Girard). Body smooth above, chestnut in color, indistinctly blotched with darker and a dark stripe through the eye and tympanum; length 25 mm.: Georgia and Florida to Arkansas and Texas.

*P. ornata* (Holbrook). Body smooth, gray, olive or reddish brown in color, with or without elongated dark spots and with a black band on each side of the body; several bright yellow spots on the sides posteriorly; length 35 mm.: Florida and South Carolina to Texas.

*P. ocularis* (Holb.). Color chestnut, with 5 longitudinal stripes; length 25 mm.; upper jaw edged with white: South Carolina and Georgia; the smallest American tree toad.

**Family 5. Ranidæ.**—Frogs. Medium sized or large *Salientia;* skin smooth; maxillary and usually vomerine teeth present; pectoral girdle firmisternal (coracoids and precoracoids do not overlap midventrally); sacral transverse processes cylindrical; toes 4-5; no parotoid glands: about 270 species, in all the geographical regions, four-fifths of which are in Africa and India; 1 genus and 17 species in the United States.

**Rana** L. Toes webbed; fingers not webbed; first finger of male swollen, especially in the spring at breeding time; vomerine teeth present; a pair of conspicuous dorso-lateral glandular ridges (Figs. 93 and 94) run the length of the back in most species: about 120 species, widely distributed throughout the world; 17 species in the United States, mostly diurnal and more or less terrestrial animals which live in moist situations on the ground near the water, to which they return to breed, and often also, when alarmed, for protection. The eggs are laid in the water in large jelly masses attached usually to sticks or vegetation. The tadpoles usually complete their metamorphosis the year in which they are born, but the green-frog and the bullfrog do not become adult until the following, or in many cases, the second year. The principal food of frogs is insects, worms and snails. Frogs have a considerable economic importance in consequence of the demand for the hind legs for food, large quantities of which appear in the fish markets of the large cities.

### Key to the United States Species of Rana

$a_1$ In the States east of the Sierra Nevadas.
  $b_1$ Dorso-lateral ridges present (Fig. 93).

$c_1$ With conspicuous large, rounded, elongate or squarish spots between the dorso-lateral ridges.
$d_1$ Skin smooth, with usually 2 rows of spots between the dorso-lateral folds.
$e_1$ Spots rounded or elongate; color tone of body green.
$f_1$ Total length three and a half times the length of the head..... *R. pipiens.*
$f_2$ Total length two and a half times the length of the head; ear with a white center..... *R. sphenocephala.*
$e_2$ Spots squarish; color tone of body brown..... *R. palustris.*
$d_2$ Skin warty; numerous spots on the back and sides.
$e_1$ Total length three times the length of head.... *R. areolata.*
$e_2$ Total length two and a half times the length of head..... *R. æsopus.*
$c_2$ Without large spots on the back.
$d_1$ Large aquatic frogs; head green..... *R. clamitans.*
$d_2$ Small wood-frogs; head brown.
$e_1$ Length of leg to the heel exceeds total length of body..... *R. sylvatica.*
$e_2$ Length of leg to the heel less than or equal to total length of body..... *R. cantabrigensis.*
$b_2$ Dorso-lateral ridges absent.
$c_1$ Very large frogs, upwards of 200 mm. long..... *R. catesbeiana.*
$c_2$ Smaller, medium sized frogs, under 100 mm. long.
$d_1$ In the northern and central States.
$e_1$ Back mottled..... *R. septentrionalis.*
$e_2$ Back plain, not mottled..... *R. virgatipes.*
$d_2$ In the Gulf States..... *R. grylio.*
$a_2$ On the Pacific slope and in the Rocky Mountain region; dorso-lateral ridges present.
$b_1$ Skin usually smooth.
$c_1$ A black cheek patch present..... *R. aurora.*
$c_2$ No black cheek patch present..... *R. onca.*
$b_2$ Skin tubercular.
$c_1$ Tympanum concealed; no red on belly..... *R. boyli.*
$c_2$ Tympanum exposed; belly and flanks with much red.
$d_1$ On the Pacific slope..... *R. draytoni.*
$d_2$ In the Great Basin..... *R. pretiosa.*

*R. pipiens* Schreber. Leopard frog (Fig. 93). Body green, gray or brown above with light-colored dorso-lateral ridges, between which are 1 to 3 irregular rows of elongate or rounded dark spots, each edged with yellow or white; similar spots on the flanks and legs; belly white; length 90 mm.; hind leg 150 mm.: North America, east of the Sierras; southward into Mexico; the commonest frog; in ponds, marshes and meadows, often at a considerable distance from water.

*R. palustris* LeConte. Pickerel frog (Fig. 94). Body pale brown above, with 2 light dorso-lateral ridges, between which are 2 rows of large squarish or rounded spots; the sides and legs with similar spots; beneath white in front and yellowish behind; length 70 mm.; leg 115

FIG. 93.—*Rana pipiens* (*from Park Museum Bulletin*).

FIG. 94.—*Rana palustris* (*from Park Museum Bulletin*).

mm.: North America, from the Atlantic to the Great Plains; common in small streams and ponds or in adjacent meadows.

*R. clamitans* Latreille. Green-frog; spring-frog. Body large, usually green on the head and shoulders and brown posteriorly, and with small irregular spots; dorso-lateral ridges light; sides and legs with

FIG. 95.—*Rana sylvatica* (*from Dickerson*).

dark bars and spots; throat of male yellow, of female white; belly white; length 100 mm.; hind leg 150 mm.: America, from the Atlantic to the Great Plains; common in ponds and streams; except the bullfrog, the most aquatic and the largest frog; development of tadpole completed in the second summer.

*R. catesbeiana* Shaw. Bullfrog. Body very large, green or greenish brown in color, being usually greener on the head and shoulders than more posteriorly; legs spotted or barred; beneath white; length 200 mm.;

hind leg 250 mm.: America from the Atlantic to the Rockies, in ponds and streams; the largest and most aquatic frog, apparently rarely leaving the water; development of tadpole completed in the second or third summer; often common.

*R. sylvatica* LeC. Wood-frog (Fig. 95). Body small and slender, with long hind legs, and brown or faun color, often with a yellowish or reddish tone; a wide dark band on the ear passing forward to the eye, and in some cases to the snout, and backward to the shoulder; legs often barred; dorso-lateral ridges light; length 48 mm.; hind leg 86 mm.: America from the Atlantic to the Great Plains; southward to South

FIG. 96.—*Rana areolata* (*from Dickerson*).

Carolina; northward to Quebec; common in the east; rare in the west; the least aquatic of the frogs, being found usually in damp woods.

*R. sphenocephala* Cope. Southern leopard frog. Color green or brown, with 2 irregular rows of green or brown spots; belly white; length 75 mm.: Georgia to Texas; common.

*R. areolata* Baird & Girard (Fig. 96). Body brown or olive in color, mottled or speckled with lighter and covered with rounded dark spots; skin rough and warty; length 75 mm.; hind leg 150 mm.: southern States from Georgia to Texas, and northward in the Valley of the Mississippi into Illinois and Indiana.

*R. æsopus* Cope. Gopher frog. Body short and squat, with a very large head; color gray or brown, with large black spots on the back and side; length 62 mm.; hind leg 74 mm.: Florida; often hiding in holes in the ground.

*R. cantabrigensis* Baird. Body small and similar to *R. sylvatica* in size and coloration, but with shorter legs; length 52 mm.; hind leg

70 mm.: northern North America from the northernmost tier of States to Alaska and Hudson Bay; habits similar to those of *R. sylvatica*.

*R. septentrionalis* Baird. Mink frog. Body small, rather stout, light olive in color with mottlings of darker; legs blotched or banded; belly light yellow; length 56 mm.; hind leg 97 mm.: Canada and the northernmost tier of States; aquatic, occurring in streams and not in ponds or lakes.

*R. virgatipes* Cope. Body small, with short legs and large ear and eye; color brown, with 4 narrow longitudinal stripes; throat yellow; sides yellowish brown, with large spots; belly white, spotted with brown; length 55 mm.: in pine barrens, New Jersey to North Carolina.

*R. grylio* Stejneger. Body large, green in color in front and olive behind, with many irregular black spots; beneath light, unspotted except posteriorly; length 125 mm.; tympanum large: southern Mississippi to Florida.

*R. aurora* B. & G. Body brown, yellowish or olive in color, often with numerous small darker spots; sides and hind legs reddish orange; belly light, mottled; skin very smooth; length 75 mm.; hind leg 125 mm.: Pacific slope from California to Vancouver Island; common towards the north.

*R. draytoni* B. & G. Body large, stout, with tuberculated skin and reddish brown in color, with or without darker spots; sides of body and under surface of legs red; belly white, spotted or marbled with brown; length 80 mm.; hind legs 140 mm.: Pacific slope from Oregon to Lower California; common; aquatic.

*R. onca* Cope. Body rather small, green or brownish in color, with several irregular rows of dark spots on the back and sides; belly white; length 60 mm.; legs short; skin smooth: Utah and Nevada.

*R. boyli* B. & G. Body small, with a warty skin and very long legs; color brown, olive or red, with obscure round brown spots; beneath white anteriorly, yellow posteriorly; dorso-lateral ridges broad and inconspicuous; length 45 mm.; hind leg 75 mm.: California and Oregon; terrestrial.

*Subspecies of R. boyli*

*B. b. boyli* Baird. A light patch on the forehead: southwestern Oregon and California.

*R. b. mucosa* Camp. Size large; ground color yellow or light brown; no light patch on the forehead: in the mountains of southern California.

*R. b. sierræ* Camp. No light patch on the head; head narrow; hind leg short: southern Sierra Nevadas.

*R. pretiosa* (B. & G.). Body large, yellowish or reddish brown in color with 2 rows of irregular black spots between the dorso-lateral ridges; beneath light, marbled with gray; flanks and under surface of legs red; length 75 mm.: Montana and Utah, and westward to the Pacific coast; common; entirely aquatic.

**Family 6. Brevicipitidæ.**—Narrow-mouthed toads. Head narrow and pointed; mouth small; no maxillary or mandibular teeth: tropical toads with 4 species and 2 genera in the United States.

**Key to the United States Genera of Brevicipitidæ**

$a_1$ Foot with one small tubercle.....1. *Gastrophryne*.
$a_2$ Foot with two large tubercles.....2. *Hypopachus*.

**1. Gastrophryne** Fitzinger. Head very narrow and pointed, much narrower than the body; skin smooth or glandular, but not warty: 3 United States species.

FIG. 97.—*Gastrophyne carolinensis (from Dickerson).*

*G. carolinensis* (Holbrook) (Fig. 97). Size very small; body stout; color dark brown to gray, with two reddish dorso-lateral stripes bordered by dark brown; back and sides speckled with black; length 25 mm.; hind leg 28 mm.: Virginia to Florida, and westward to Texas; northward in the Mississippi Valley to southern Indiana.

*G. areolata* (Strecker). Color light gray above, marbled with brown; under surface light gray, with closely placed pale spots; skin of back highly glandular; length 22 mm.: southeastern Texas.

*G. texensis* (Girard). Color gray or brownish above, speckled or spotted with black spots tending to form longitudinal rows; skin of back smooth: Texas.

**2. Hypopachus** Keferstein. Head small; body large; limbs short; no vomerine teeth: 1 species.

*H. cuneus* Cope. Color light brown or grayish brown, sometimes tinged with olive, with a pale median vertebral line; length 41 mm.; hind leg 46 mm.: southwestern Texas.

**2. The Eggs and Larvæ.** In the identification of the freshly laid egg-masses of frogs and toads the first feature to be examined is the form and condition of the jelly in which the eggs are imbedded and its location in the water; the time of the year when the eggs are found is also of importance, whether in the early spring, the later spring or the summer. The egg is a spherical body ranging from 0.9 mm. to 2.4 mm. in diameter, in the different species, which has two distinct surfaces, the dark, pigmented upper surface, or animal pole, and the white or yellow under surface, or vegital pole; the pigmented portion is much the larger in extent. The egg is surrounded immediately by a spherical envelope of jelly, inside of which and next to the egg is, in most species, a second or inner envelope.

**Key to the Eggs of some of the common Eastern Frogs and Toads**

$a_1$ Eggs laid in a single row within a long spiral chord of jelly which lies on the bottom or is looped around plants or sticks; diameter of chord 3.4 to 4 mm.; number of eggs 4,000 to 7,000; season of egg laying April, May and June. *Bufo americanus.*

$a_2$ Eggs laid in a mass or singly.

$b_1$ Eggs laid in a firm consistant mass around sticks, twigs, etc., or free, and usually near the surface of the water.

$c_1$ Inner jelly envelope of egg small and distinct.

$d_1$ Vegital pole of egg yellow; animal pole brown; egg mass globular; season of egg laying April and first half of May; number of eggs 2,000 to 3,000. . . . . *Rana palustris.*

$d_2$ Vegital pole of egg white; animal pole brown; egg mass elongate; season of egg laying latter part of March to middle of May; number of eggs 3,500 to 4,500. . . . . *Rana pipiens.*

$c_2$ Inner jelly envelope of egg large and indistinct, or apparently absent; vegital pole of egg white; animal pole black; egg mass globular; season of egg laying middle of March to end of April; number of eggs 2,000 to 3,000. . . . . *Rana sylvatica.*

$b_2$ Eggs laid in large loose masses or in small bunches or singly.

$c_1$ Eggs laid in large loose masses at or near the surface of the water; vegital pole of egg white; animal pole black.

$d_1$ Eggs laid usually in one continuous film, one or two eggs thick, on the surface of the water, among plants; season of egg laying latter part of May to middle of August; inner jelly envelope of egg distinct, elliptical in shape; number of eggs 3,500 to 4,000. . . . . *Rana clamitans.*

$d_2$ Eggs laid either in a wide film or in an irregular mass attached to vegitation or to sticks; season of egg laying middle of June to middle of July; no individual jelly envelope to egg; number of eggs 12,000 to 20,000.....*Rana catesbeiana.*

$c_2$ Eggs laid in small bunches or singly.

$d_1$ Egg with 2 jelly envelopes, the inner one distinct; vegital pole of egg yellowish or cream; eggs laid in small bunches (4 to 25) on surface of water either attached or free; season of egg laying middle of May to middle of June; number of eggs 1,500 to 2,000.....*Hyla versicolor.*

$d_2$ Egg with but one jelly envelope; vegital pole of egg white.

$e_1$ Eggs laid in bunches (20 to 100) attached to sticks and grass beneath the surface of the water; season of egg laying middle of March to middle of April; number of eggs 500 to 800.....*Pseudacris triseriatus.*

$e_2$ Eggs laid singly or in small bunches (4 to 12) attached to grass beneath the surface of the water; season of egg laying middle of March to May; number of eggs 800 to 1,000.*Hyla crucifer.*

In the identification of the well-grown tadpoles the features to be first noticed are the relative size and color of the body and the relative size and color of the tail. The position of the spiracle, through which the respiratory water is discharged, the position of the anus and the number of rows of labial teeth, which are situated above and below the mouth, are also important.

**Key to the Tadpoles of some of the common Eastern Frogs and Toads**

$a_1$ Anus median; spiracle sinistral; tail cloudy, translucent, rounded at the end; belly very dark, iridescent; greatest length 28 mm.....*Bufo americanus.*

$a_2$ Anus dextral; spiracle sinistral; greatest length over 30 mm.

$b_1$ Eyes lateral in position, being visible from the ventral as well as from the dorsal aspect of the body; upper caudal crest extends almost to the eyes.

$c_1$ Tail covered with black blotches and scarlet or vermilion in color; belly white.....*Hyla versicolor.*

$c_2$ Tail heavily pigmented with black blotches on the outer edges; belly cream, iridescent.....*Hyla crucifer.*

$b_2$ Eyes dorsal in position; upper caudal crest not extending beyond the spiracle.

$c_1$ Labial teeth, 3 or 4 rows above the mouth and 4 rows below it; a creamy line along the upper jaw region;

belly pinkish; greatest length 47 mm.....*Rana sylvatica.*

$c_2$ Labial teeth, 2 or 3 rows above the mouth and 3 rows below it.

$d_1$ Tail spotted with black; belly straw color, not iridescent; greatest length 145 mm.....*Rana catesbeiana.*

$d_2$ Tail greenish, mottled with brown; belly cream color; greatest length 84 mm.....*Rana clamitans.*

$d_3$ Caudal crest very dark purplish black, mottled; belly conspicuously iridescent; greatest length 74 mm.....*Rana palustris.*

$d_4$ Caudal crest very light, translucent, with a few scattered dots; belly deep cream with a bronzy iridescence; greatest length 84 mm.....*Rana pipiens.*

## CLASS 3. REPTILES (Reptilia)

The reptiles are cold-blooded vertebrates whose bodies are covered with horny scales or plates, and which have claws on their digits. The legs are well developed, when present, and are often adapted for rapid running, but they do not usually support the body above the ground except during locomotion. Respiration is always pulmonary. The skeleton, including the skull, is well developed and ossified, the skull articulating by a single condyle. The eggs are large and are usually laid on or in the ground, even when the animals are aquatic, although many species are ovoviviparous, and the embryo is meroblastic and provided with an amnion and allantois; the young animals resemble the parents, when born, there being no postnatal metamorphosis.

**History.**—The cold-blooded, egg-laying quadrupeds were named *Amphibia* by Linnæus, and subdivied into two orders, the *Serpentia* and *Reptilia*, the latter order including turtles, frogs and lizards. Opinion fluctuated as to the exact relation existing between amphibians and reptiles for almost a century, although Blainville as early as 1816 correctly defined them, until near the middle of the last century the anatomical and embryological studies of Johannes Müller, Gegenbaur and others definitely established the two groups as distinct and equivalent classes.

The foundation of our knowledge of American reptiles was laid principally by John Edward Holbrook, Spencer F. Baird and Edward D. Cope; the work of Cope on *The Crocodilians, Lizards and Snakes of North America* being the most important single one on the subject; in more recent times the works of Leonhard Stejneger have been very important.

**Number of Species and Distribution.**—About 3,500 species of reptiles are known at the present time, most of which live in the warmer regions of the world. There are no reptiles in Arctic regions, and but few in the colder portions of the Temperate zone. About 300 species are known in the United States, which are grouped in 4 orders.

### Key to the Orders of Reptiles

$a_1$ Jaws with teeth.

$b_1$ Teeth set in alveoli; anus a longitudinal slit..... 1. *Crocodilia.*

$b_2$ Teeth not set in alveoli; anus a transverse slit.

$c_1$ Two pairs of limbs present (rarely absent); eyelids, external ear-opening and tympanum usually present; lizards.....2. *Lacertilia.*

$c_2$ Limbs absent; eyelids, external ear-opening and tympanum absent; snakes.....3. *Serpentes.*

$a_2$ Jaws without teeth; turtles.....4. *Testudinata.*

**Order 1. Crocodilia.**—The crocodiles and alligators are elongated, aquatic reptiles of large size, whose bodies are covered with scales and plates and which have two pairs of short legs and a laterally compressed tail. There are five digits on the fore leg and four on the hind leg, the latter being webbed and the former usually so. Only the three inner digits of each foot have claws. The scales are arranged in transverse rows, the dorsal ones having high keels and being supported beneath by corresponding plates of dermal bone. The head is compactly built; the quadrate bone is immovable and the palate is bony. The jaws are powerful and the teeth are set in alveoli. The tympanum is exposed, but is protected by a movable fold of the skin. The nostrils lie close together and each can be closed by a valve. The eye has an upper and a lower lid and a nictitating membrane. The order contains a single family.

**Habits and Distribution.**—The Crocodilia live in streams and ponds in the warmer parts of the earth. The American crocodile and the marine crocodile of the East Indies also enter salt water, and may be found far from land. All are carnivorous and feed on all kinds of vertebrate animals. They are oviparous, the eggs, which have a hard shell and somewhat resemble goose eggs, being laid in large nests, where they are guarded by the female while the sun incubates them. Most species hibernate or æstivate in the mud for two or three months or more each year.

**Family Crocodylidæ.**—With the characters of the order: about 8 genera and 20 species, of which 2 genera and species occur in the United States.

### Key to the Genera of United States Crocodilia

$a_1$ Snout broad (Fig. 98), the closed mouth not showing the fourth mandibular tooth.....1. *Alligator.*

$a_2$ Snout pointed; fourth mandibular tooth exposed.....2. *Crocodylus.*

**1. Alligator** Cuvier (Fig. 98). Head broad; snout blunt; fourth mandibular tooth fits into a pit in the upper jaw; nasal aperture separated by a bony septum: 2 species, one in the Yang-tse-kiang, China.

*A. mississippiensis* (Daudin). Alligator. Body from 2 to 4.5 m. long, of which half is the tail; weight up to 500 lbs.; color dark brown or blackish, lighter or blotched on the sides and beneath; 19 to 20 teeth on each side of each jaw: North Carolina to the Gulf and westward to the Rio Grande; in the Mississippi as far north as Rodney, Miss.; 20 to 40 eggs in a nest, which hatch in about 2 months. The alligator has a loud voice, which can be heard a mile or more.

FIG. 98.—Heads of American alligator and American crocodile; alligator on left (*from Reese after Ditmars*).

**2. Crocodylus** Laurenti (Fig. 98). Head long and pointed; fourth mandibular tooth fits into a notch in the upper jaw and is exposed when the mouth is closed; nasal aperture not divided: 8 species, in America, Africa, Asia and Australia. Of these the Nile crocodile, *C. niloticus*, which may attain a length of 6 m., is the best known; the marine crocodile, *C. porosus*, which is found from India to Australia, is the largest species, attaining a length of 10 m.

*C. acutus* Cuvier. Body up to 7 m. long and slender; average adult length 3.5 m.; color olive green or gray: southern Florida and the greater Antilles, except Porto Rico, to Ecuador; northward to Lake Worth, Florida; in salt marshes; not common.

**Order 2. Lacertilia** (*Sauria*). Lizards. Elongated reptiles whose bodies are covered with scales, and with usually two pairs of pentadactyle limbs and a transverse anal opening. The head is of firmer structure than in the snakes, the two halves of the lower jaw being immovably bound together and the upper jaw being firmly joined with the cranium; the quadrate bone is, however, movable as in the snakes. The tympanum is not at the surface, and the ear-opening is often protected by special scales. The eye has a upper and a lower lid and a nictitating membrane. Most lizards possess the vestiges of a pineal eye, which often appears on the top of the head just back of the paired eyes. Teeth are always present and are either acrodont or pleurodont, and are often present on the gums as well as the jaws. The tongue is well developed and usually protractile, and may be bifid or not. The tail is mostly long and fragile

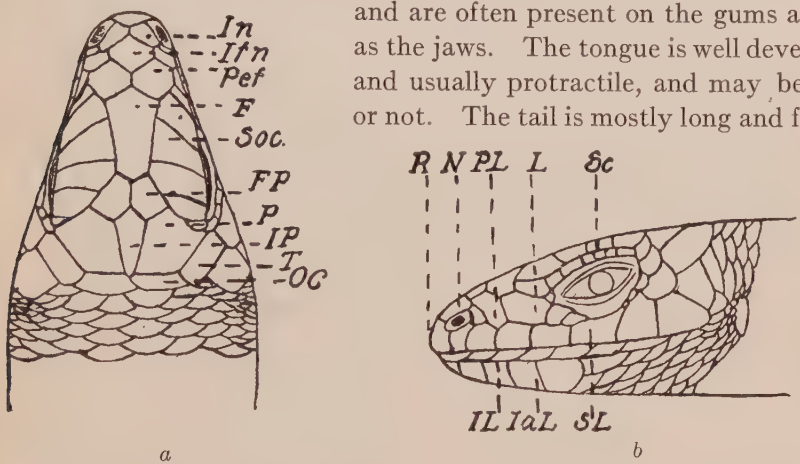



FIG. 99.—Head of a lizard (*Plestiodon fasciatus*): *a*, dorsal view; *b*, lateral view: *F*, frontal; *FP*, frontoparietal; *IaL*, infralabial; *Ifn*, interfrontonasal; *IL*, lower labial; *In*, internasal; *IP*, interparietal; *L*, loreal; *N*, nasal; *Oc*, occipital; *P*, parietal; *Pef*, prefrontal; *PL*, preloreal; *R*, rostral; *Sc*, superciliary; *SL*, upper labial; *Soc*, supraocular; *T*, temporal *from Cope*).

and easily broken off; it grows again, but the lost vertebræ are not regenerated. Most lizards lay eggs; a few are ovoviviparous.

**Habits and Distribution.**—Lizards feed mainly on insects and worms, and are mostly active, terrestrial animals. The larger species feed also on birds, small mammals and eggs. A number of species are vegetarians. Metachrosis is common, and in some species, as the chameleon, very remarkable. About 1,300 species are known, which inhabit the warmer regions of the earth. About 100 species are known in this country, ranging, in one or two cases, as far north as Canada: they are grouped in 10 families.

**On the Identification of Lizards.**—The size and general form, whether elongate or not, or large or small, are first to be observed,

together with the length of the head, body and tail in millimeters and that of the tail alone. The color markings are also important, but it must be remembered that many lizards are extremely variable in color, as well as exhibiting metachrosis in a high degree. Young animals also often differ totally from the adult in coloration. The character of the scales or plates and the differences between those on the back and the belly are sometimes important, as well as the number of transverse and longitudinal rows. Those immediately in front of the anus are often of characteristic form and number. The plates on the head are usually characteristic and a description of them often enters into a detailed description (Fig. 99), the supraocular scales over the eye, and the upper and lower labials, which bound the lips, being especially important. The character of the tongue is also usually to be noticed; in some families it is thick and little protractile, in others it is similar to the tongue of snakes and may be projected from the mouth as an important tactile organ. In most lizards a row, sometimes double, of conspicuous pores is present on the inner surface of the thigh; they are the *femoral pores* (Fig. 103). The teeth are usually conical and are never set in alveoli, but become ankylosed usually to the bone of the jaw, either by their base to the edge of the jaw bone, when they are spoken of as *acrodont teeth*, or by their side just inside the edge of the bone, when they are called *pleurodont teeth*.

### Key to the Families of American Lacertilia

$a_1$ Legs present.
  $b_1$ Skin soft, with minute granular scales.
    $c_1$ Eyes like those of snakes, without functional eyelids... 1. *Gekkonidæ.*
    $c_2$ Eyelids present..... 2. *Eublepharidæ.*
  $b_2$ Skin usually scaly.
    $c_1$ Tongue thick and not protractile..... 3. *Iguanidæ.*
    $c_2$ Tongue protractile.
      $d_1$ Conspicuous lateral fold present..... 4. *Anguidæ.*
      $d_2$ No such lateral fold.
        $e_1$ Body large and thick; no femoral pores..... 6. *Helodermatidæ.*
        $e_2$ Body very small and slender; femoral pores present or not.
          $f_1$ Femoral pores present.
            $g_1$ No movable eyelids; pupils vertical.... 7. *Xantusiidæ.*
            $g_2$ Eyelids movable; pupils round..... 8. *Teiidæ.*
          $f_2$ Femoral pores absent..... 9. *Scincidæ.*
$a_2$ Legs wanting; body vermiform.
  $b_1$ No scales present; eyes concealed..... 10. *Leposternidæ.*
  $b_2$ Scales present; eye a narrow slit..... 5. *Anniellidæ.*

**Family 1. Gekkonidæ.**—Geckos. Mostly small lizards with a soft skin covered with minute granular scales; digits usually flattened and with adhesive disks; eyes large and without lids; vertebræ amphicœlous: 60 species, all tropical; 4 species in the United States, some adventitious, *Sphærodactylus cinereus* Mac Leay, a Cuban species, and *Hemidactylus turcicus* (L.), a Mediterranean species, having become established at Key West.

**Sphærodactylus** Wagler. Digits expanded at their tips and without claws: 20 species in Mexico, Central America and the West Indies.

FIG. 100.—*Coleonyx variegatus (from Ditmars).*

*S. notatus* Baird. Reef gecko. Body very small, 60 mm. long; tail 30 mm.; color brownish yellow, with scattered reddish brown spots; scales on back strongly keeled: southern Florida, Cuba and Bahamas.

**Family 2. Eublepharidæ.**—Geckos. Similar to the *Gekkonidæ;* eyes large, with movable lids; vertebræ procœlous: 7 species, 2 in the United States.

**Coleonyx** Gray. Digits not dilated, with very small claws: 3 species.

*C. variegatus* (Baird). The banded gecko (Fig. 100). Body small, 75 mm. long, yellow in color, and either with about 13 broad brown transverse bands or with brown spots and blotches: Texas to California; rather common; not poisonous, although often so thought.

**Family 3. Iguanidæ.**—Iguanas; swifts. Tongue thick and nonprotractile; scalation fine; teeth pleurodont; femoral pores usually present; eyelids well developed; pupil round: 50 genera and over 300 species, all American except a few East Indian, and tropical and subtropical; mostly insectivorous; 50 species in the United States.

**Key to the Genera of Iguanidæ**

$a_1$ Femoral pores absent, toes flattened (Fig. 101)..... 1. *Anolis.*

$a_2$ Femoral pores present, toes not flattened.

$b_1$ A middorsal crest of enlarged scales present..... 2. *Dipsosaurus.*

$b_2$ No middorsal crest of enlarged scales present.
$c_1$ Body lizard-like, head without horns.
$d_1$ Tail blunt, superciliary scales not imbricate..... 3. *Sauromalus.*
$d_2$ Tail long and attenuate; superciliary scales imbricate.
$e_1$ Upper labial scales oblique and imbricate (Fig. 102).
$f_1$ Tympanum distinct; ear-opening evident.
$g_1$ A fringe of elongate scales on the toes..... 6. *Uma.*
$g_2$ No digital fringe present..... 5. *Callisaurus.*
$f_2$ Tympanum hidden; ear-opening absent..... 7. *Holbrookia.*
$e_2$ Upper labial scales not oblique or imbricate (Fig. 99).
$f_2$ Head plates small..... 4. *Crotaphytus.*
$f_2$ Head plates large.
$g_1$ A collar of enlarged scales crossing the throat..... 8. *Uta.*
$g_2$ No collar across the throat..... 9. *Sceloporus.*
$c_2$ Body broad and flat, toad-like; head with spines or horns..... 10. *Phrynosoma.*

**1. Anolis** Daudin. Body slender and more or less compressed; head flattened; throat of male with a large ventral fold of skin which when dilated is fan-shaped: 120 species of arboreal, brilliantly colored lizards confined to tropical America; 1 species in the United States.

FIG. 101.—Foot of *Anolis carolinensis* (*from Dilmars*).

*A. carolinensis* Voigt. Chameleon (Fig. 101). Length 175 mm.; tail 120 mm.; color-changes very remarkable and equal to those of the true chameleon of southern Europe, the color being usually green or brown, yellow, gray or black; throat-fan, when dilated, crimson; middle portion of the toes expanded: coastal regions of the southern States, from the Neuse River, North Carolina, into Mexico; abundant; diurnal and insectivorous; easily tamed.

**2. Dipsosaurus** Hallowell. Large, thick-bodied lizards with a middorsal crest of enlarged scales: 1 species.

*D. dorsalis* (Baird & Girard). Keel-backed lizard. Body 380 mm. long; tail 180 mm.; color pale brown, with wavy longitudinal brown or black lines on the back: deserts of southwestern States and Mexico; herbivorous.

**3. Sauromalus** Duméril. Large, blunt-tailed lizards with very small imbricated scales; claws very thick and strong; a prominent neck-fold: 2 species, 1 in the United States.

*S. obesus* (Baird). Chuck-walla. Body thick and broad and 300 mm. long; tail 140 mm.; greatest length 400 mm.; color black or dark

brown; tail whitish; belly reddish: deserts of southwestern States; northward into Nevada and Utah; herbivorous; used for food; often abundant.

**4. Crotaphytus** Holbrook. Large, brightly-colored lizards with a very long, tapering tail and small granular scales and a neck-fold: 5 species, 4 in the United States.

**Key to the Species of Crotaphytus**

$a_1$ One or 2 rows of enlarged scales between the orbital areas.
  $b_1$ A double black collar on the neck.....*C. collaris.*
  $b_2$ No collar on the neck.....*C. reticulatus.*
$a_2$ Several rows of small scales between the orbital areas.
  $b_1$ Snout short, truncate in profile.....*C. silus.*
  $b_2$ Snout longer.....*C. wislizenii.*

*C. collaris* (Say). Collared lizard; mountain boomer. Body short; head very large; length 300 mm.; tail 200 mm.; color green or gray, with numerous white or yellow spots; behind the head are 2 black rings, separated by a white or yellowish space; throat usually orange: central and southern Missouri to central California and southwards; northward into Idaho; in dry rocky places; omnivorous; often abundant; it sometimes runs on the hind legs, like a kangaroo.

FIG. 102.—*Callisaurus ventralis (from Cope).*

*C. reticulatus* Baird. Similar to *C. collaris* in form and size; color yellowish brown or gray, with a net-work of pale gray or yellow: southwestern Texas; rare.

*C. wislizenii* Baird & Girard. Leopard lizard. Length 300 mm.; tail 210 mm.; color brown, with black blotches and red dots; back and tail with yellowish or red transverse bands: the Great Basin from eastern Oregon into southern California and Mexico, in desert places; abundant.

*C. silus* Stejneger. Similar to *C. wislizenii* but with a shorter and more truncate snout, and more sharply defined light cross bands: San Joaquin Valley.

**5. Callisaurus** Blainville. Body stout; tail rather short; neck-fold present: 4 species, 1 in the United States.

*C. ventralis* (Hallowell) (*C. draconoides* Cope). Gridiron-tailed lizard (Fig. 102). Length 180 mm.; tail 100 mm.; color gray or greenish, thickly spotted with white; 2 rows of large spots on back; under surface of tail of male white, with 4 wide black bars: western Texas to California; northward into Utah and Nevada; in desert and arid regions; very common; when running it curls its tail over its back.

**6. Uma** Baird. Body rather stocky, with 2 rows of subdigital scales, and a lateral digital fringe of elongate scales: 1 species.

*U. notata* Baird (*U. scoparia* Cope). Length 220 mm.; tail 120 mm.; ground color black, with numerous large round, white spots, each with a black center; abdomen white, with a black spot on each side: deserts of southeastern California.

**7. Holbrookia** Girard. Spotted lizards. Small, rather slender, flattened lizards with very small scales; color pale, with 2 rows of dark blotches on the back, a row of more or less indistinct blotches on the side and 2 black bars on the lower portion of each side; upper labials imbricate; no external ear-opening: 7 species, 6 in the United States.

**Key to the United States Species of Holbrookia**

$a_1$ Tail flat, with broad black bands beneath..... *H. texana.*
$a_2$ Tail round.
  $b_1$ Tail longer than the body in both sexes.
    $c_1$ Dorsal scales very small, convex or keeled; tail very long... *H. propinqua.*
    $c_2$ Dorsal scales larger, flat.
      $d_1$ Size large; femoral pores usually more than 12..... *H. elegans.*
      $d_2$ Size smaller; femoral pores usually less than 12..... *H. pulchra.*
  $b_2$ Tail shorter than the body in females, and usually also in males.
    $c_1$ Black subcaudal spots usually present; dorsal spots sharply defined..... *H. lacerata.*
    $c_2$ No subcaudal spots; dorsal spots not sharply outlined..... *H. maculata.*

*H. texana* (Troschel). Length 150 mm.; tail with black cross bars on the under surface, almost exactly like *Callisaurus ventralis*, and held over the body when the animal is running; hind foot half the length of head and body: western Texas to eastern Arizona.

*H. propinqua* Baird & Girard. Length 120 mm.; tail 70 mm.; dorsal spots frequently wanting; tail proportionately long; upper labials 7: southern Texas.

*H. elegans* Bocourt. A large, smooth scaled form with sharply defined dorsal spots: deserts west of Tucson, Arizona.

*H. pulchra* Schmidt. A small, smooth scaled form with sharply defined dorsal spots: higher altitudes in mountains of southern Arizona.

*H. lacerata* Cope. Under surface of tail with black spots; dorsal spots large, sharply defined; length 106 mm.; tail 52 mm.: central Texas.

*H. maculata* Girard. Length 100 mm.; tail 50 mm.; coloration variable: Nebraska and Wyoming to Arizona, southward into Mexico; in dry, rocky places, feeding mainly on insects.

**8. Uta** Baird & Girard. Swifts. Small, flattened, active lizards with small scales; ear distinct; collar present; tail longer than the body: about 24 species in the southwestern United States and Mexico.

**Key to the Species of Uta in the United States**

$a_1$ Scales on the back uniform, not abruptly larger than those on the sides (Fig. 103).
  $b_1$ Scales on the back very small, perfectly smooth.....*U. mearnsi.*
  $b_2$ Scales on the back larger and more or less sharply keeled.....*U. stansburiana*
$a_2$ Scales on the back enlarged, sharply distinct from the smaller lateral scales (Fig. 104).
  $b_1$ Tail very long, more than twice the length of the head and body; usually without a median dorsal row of small scales.....*U. graciosa.*
  $b_2$ Tail shorter; 1 or 2 rows of small scales on the middorsal line, between the rows of enlarged scales.
    $c_1$ Lateral caudal scales small and smooth.....*U. levis.*
    $c_2$ Lateral caudal scales larger and more sharply keeled.*U. ornata.*

*U. mearnsi* Stejneger. Size large; length 230 mm.; tail 150 mm.: western border of the Colorado desert, in rocky situations.

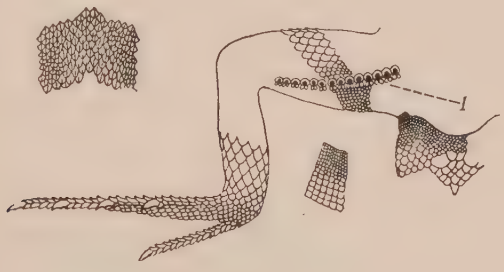


FIG. 103.—Femoral pores on hind leg and scales of back of *Uta stansburiana:* 1, femoral pores (*from Cope*).

*U. stansburiana* B. & G. (Fig. 103). Length 120 mm.; tail 60 mm.; color dark green or gray, with rows of small light and dark blotches on the back which are surrounded by scattered bluish dots: western Texas to California; northward into Utah, Idaho and Oregon; very common in deserts.

*Subspecies of U. stansburiana*

*U. s. stansburiana* B. & G. In northerly portion of range.

*U. s. stejnegeri* Schmidt. In the central portion of the range.

*U. s. hesperis* Richardson. In the western portion of the range.

*U. graciosa* (Hallowell). Length 200 mm.; tail 140 mm.; color gray or reddish, with a series of dark, wavy cross bars on each side: southern California, Arizona and Nevada; lives in small trees and bushes.

*U. levis* Stejneger. Six middorsal rows of enlarged scales; color uniform pale with markings: New Mexico; canyons southeastern Utah and western Colorado.

*U. ornata* B. & G. (Fig. 104). Length 150 mm.; color gray, with wavy black cross bands: western Texas to southern California; northward into Utah.

FIG. 104.—Scales of back of *Uta ornata* (*from Cope*).

*Subspecies of U. ornata*

*U. o. ornata* B. & G. In Texas.
*U. o. linearis* Baird. In southern Arizona.
*U. o. symmetrica* Baird. In the Colorado desert.

**9. Sceloporus** Wiegmann. Spiny swifts. Small, active lizards with large-keeled, sharply pointed and bristling scales; large supraocular scales present; ear distinct; no neck fold: about 35 species, mostly in desert regions of tropical America, several species, not here mentioned, entering the United States from Mexico.

**Key to the more common United States Species of Sceloporus**

$a_1$ A single row of large supraocular scales, bordered on each side by a single row of small scales.
  $b_1$ Median row of small scales extending around forward two-thirds only of cresentic margin of supraocular scales. . . *S. clarki.*
  $b_2$ Median row of small scales extending completely around cresentic margin. . . . . *S. spinosus.*
$a_2$ A single row of large supraocular scales, bordered by a single median and 2 ventral rows of small scales (Fig. 105).
  $b_1$ A broad black collar on the sides of the neck. . . . . *S. jarrovi.*
  $b_2$ No collar present.
    $c_1$ In the Great Basin and Pacific region. . . . . *S. occidentalis.*
    $c_2$ In the Great Plains region and west to California. . . *S. consobrinus.*
    $c_3$ In central and east-central Florida. . . . . *S. woodi.*
$a_3$ Supraocular plates similar to $a_2$, but wrinkled and sometimes with 3 ventral rows of small scales. . . . . *S. undulatus.*
$a_4$ Two rows of supraocular scales, bordered above by 1 and below by 1 or 2 rows of small scales.
  $b_1$ A broad, black collar round the neck. . . . . *S. torquatus poinsetti.*
  $b_2$ No collar present. . . . . *S. graciosus.*

*S. undulatus* (Latreille). Pine lizard; fence lizard; swift (Fig. 106). Length 140 mm.; tail 70 mm.; scales large and rough; color grayish or greenish, with a series of black, wavy cross bars on the back and a pale band extending backward from the eye on each side: from the Atlantic

to the Pacific, from New Jersey, Michigan and Oregon southward; common; in dry, sandy places, especially in pinelands; tail very brittle.

*S. clarki* Baird & Girard. Length 220 mm.; tail 120 mm.; color gray or brown, with dark transverse bands; a green spot in each scale on the back; broad black collar interrupted above: New Mexico, Arizona and Mexico; common.

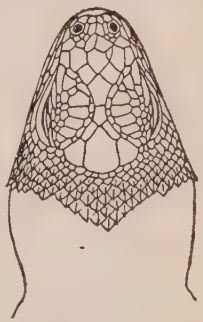


FIG. 105.—Head of *Sceloporus occidentalis* (*from Cope*).

*S. consobrinus* B. & G. Similar to *S. undulatus*, but with 2 pale lateral stripes instead of cross bars and smooth head scales: Dakota to Texas and westward to California; common.

*S. spinosus* Wiegmann. Similar to *S. undulatus*, but 250 mm. long, with coarsely bristling scales, with a broad, pale band on each side and an oblong black patch on each shoulder: Florida to New Mexico and Mexico.

*S. graciosus* B. & G. Color brown or olive, with 2 yellow stripes on each side enclosing a dark band and a round black spot in front of each fore leg: Great Basin region, from Oregon and Idaho to Nevada and southern California; common.

FIG. 106.—*Sceloporus undulatus* (*from Fowler*).

*S. torquatus poinsetti* B. & G. Length 250 mm.; tail 110 mm.; body stout; tail short and blunt; scales very coarse and pointed; color dull olive with a broad, black collar bordered with yellow: Texas to Arizona and Mexico.

*S. jarrovi* Cope. Length 177 mm.; tail 80 mm.; color bluish black, with a light spot on each scale and a broad black spot on each side of the neck: southern Arizona.

*S. occidentalis* B. & G. (Fig. 105). Length 200 mm.; tail 100 mm.; color greenish gray, with 2 rows of wavy cross bars on the back; legs very long: the Great Basin and mountain ranges of the Pacific region from Oregon and Idaho to Nevada and southern California; common in rocky districts.

*S. woodi* Stejneger. Length 103 mm.; tail 65 mm.; fourth toe extremely long: central and east-central Florida.

**10. Phrynosoma** Wiegmann. Horned toads; horned lizards. Body short, wide and flattened; tail short; hinder border of head armed with

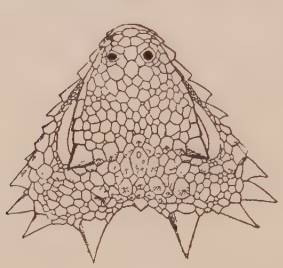


FIG. 107.—Head of *Phrynosoma cornutum* (*from Cope*).

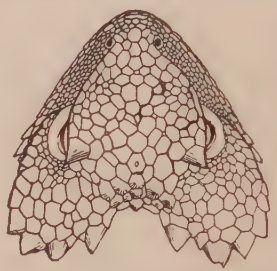


FIG. 108.—Head of *Phrynosoma hernandesi* (*from Cope*).

long, sharp, horn-like spines; long spines also often along the sides of the body and tail: about 17 species, in the desert regions of the southwest and of Mexico; terrestrial, living largely on insects; viviparous; harmless.

**Key to the United States Species of Phrynosoma**

$a_1$ Tympanum not covered with scales.
  $b_1$ Horns long and large (Fig. 107); 2 rows of enlarged marginal spines on the sides of the body.
    $c_1$ In the Great Plains region.....*P. cornutum.*
    $c_2$ In California.....*P. blainvilli.*
    $c_3$ In Arizona.....*P. solare.*
  $b_2$ Horns small or rudimentary (Fig. 108); 1 row of marginal spines or none.
    $c_1$ No enlarged marginal spines present.....*P. modestum.*
    $c_2$ One row of enlarged marginal spines present.
      $d_1$ Horns reduced to tubercles.....*P. douglassi.*
      $d_2$ Horns small but distinct.
        $e_1$ Median horns directed backwards.....*P. hernandesi.*
        $e_2$ Median horns directed upwards.....*P. ornatissimum.*
$a_2$ Tympanum covered with scales.
  $b_1$ Horns short; 6 to 12 femoral pores.....*P. platyrhinos.*
  $b_2$ Horns long; 16 to 20 femoral pores.....*P. m'calli.*

*P. cornutum* (Harlan). Common horned toad (Fig. 107; Fig. 109). Length 150 mm.; tail 45 mm.; width of body 60 mm.; color gray, spotted

with brown and with a median yellow band; head spines very long: Kansas and Nebraska to Texas and Colorado; common.

*P. blainvilli* Gray. Length 150 mm.; tail 56 mm.; color light brown: California, southward and eastward of San Francisco; common.

*Subspecies of P. blainvilli*

*P. b. blainvilli* Gray. Southern California; Lower California.

*P. b. frontale* Van Denburgh. In the northern portion of the range.

FIG. 109.—*Phrynosoma cornutum (from Ditmars).*

*P. solare* Gray. Length 140 mm.; tail 51 mm.; 4 equally long occipital horns form with the lateral horns an uninterrupted series: deserts of Arizona; westward to Tucson.

*P. modestum* Girard. Length 95 mm.; color yellowish brown, sometimes pinkish, with a black patch on each side of the nape: Texas to Arizona; common.

*P. douglassi* (Bell). Length 100 mm.; tail 26 mm.; color brown, with 2 rows of large dark blotches on the back; horns rudimentary; abdominal scales smooth: Oregon and Washington to Salt Lake Valley; common.

*Subspecies of P. douglassi*

*P. d. douglassi* (Bell). In the western and central portion of range.

*P. d. ornatum* Girard. In the Salt Lake Valley.

*P. hernandesi* (Girard) (Fig. 108). Length 94 mm.; tail 30 mm.; color yellowish or brown, with a row of large, obscure middorsal spots: Colorado and Utah to New Mexico and Arizona; common.

*P. ornatissimum* (Girard). Length 124 mm.; color yellowish, sometimes pinkish, with 2 rows of large dark brown spots on the back: deserts of Arizona, New Mexico and Colorado.

*P. brevirostre* (Girard). Length 94 mm.; color similar to *P. ornatissimum:* Wyoming, western Kansas and Nebraska.

*P. platyrhinos* Girard. Length 120 mm.; tail 40 mm.; color pinkish gray or brown, with dark cross bands on the back; a large dark patch on each side of the nape; scales small and smooth; tympanum covered: eastern California and the Great Basin from Idaho to Arizona; common.

*P. m'calli* (Hallowell). Length 100 mm.; tail 34 mm.; color gray with a narrow middorsal line with 2 rows of round spots on each side: deserts of the lower Colorado; rare.

**Family 4. Anguidæ.**—Elongated, often more or less snake-like lizards with weak legs or without any; tongue bifid and extensile; teeth pleurodont; body with a conspicuous lateral fold: about 44 species, in the New and Old Worlds, many in Mexico and Central America, 7 in the United States.

**Key to the United States Genera of Anguidæ**

$a_1$ Four legs present ..... 1. *Gerrhonotus.*
$a_2$ Legs wanting ..... 2. *Ophisaurus.*

1. **Gerrhonotus** Wiegmann. Slender lizards with 2 pairs of weak legs; ears distinct; no femoral pores; tail long and brittle: 19 species, 6 in the United States.

**Key to the United States Species of Gerrhonotus**

$a_1$ In the Pacific States.
  $b_1$ Dark ventral lines between the longitudinal rows of scales present or absent.
    $c_1$ Dorsal scales strongly keeled, in 16 longitudinal rows.
      $d_1$ Temporal scales smooth ..... *G. cæruleus.*
      $d_2$ Lower temporal scales keeled ..... *G. palmeri.*
    $c_2$ Dorsal scales weakly keeled, in 14 rows ..... *G. principis.*
  $b_2$ Dark ventral lines on the middle of the longitudinal rows of scales ..... *G. scincicauda.*
$a_2$ In the southwestern States; scales obscurely keeled.

$b_1$ Back with alternating black and white bars.....*G. nobilis.*
$b_2$ Back with a few obscure cross bars.....*G. infernalis.*

*G. cæruleus* Wieg. Length 290 mm.; tail 180 mm.; color brown or olive with numerous dark cross bands, spotted with white; dorsal scales strongly keeled and in about 16 regular rows; longitudinal rows 47: coast region of California, chiefly north of San Francisco.

*G. scincicauda* (Skilton). Length 270 mm.; tail 160 mm.; color brown or gray with 10 to 14 dark rings across the back, and spotted with white; dorsal scales strongly keeled and in 14 transverse rows and about 51 longitudinal rows: California; common.

*G. palmeri* Stejneger. Similar to *P. scincicauda* but much less elongated and with a different coloration, being either uniform dark olive brown dotted with black and white on the sides or pale bluish drab clouded with irregular blotches: central California, on the western slopes of the Sierra Nevada.

*G. principis* (Baird & Girard). Length 300 mm.; tail 190 mm.; color light brown, with a middorsal series of irregular dark blotches; dorsal scales obscurely keeled and in 16 rows: western Washington, Oregon and Vancouver Island.

*G. nobilis* (B. & G.). Body very small and slender; color light yellowish olive; back with 10 broad black bars, each with a whitish bar behind; tail with 30 half rings; sides with narrow black bars: Texas to Arizona.

*G. infernalis* Baird. Body very small, depressed; tail twice the length of the head and body; color light olive with 7 or 8 obscure dark bars; dorsal scales keeled, lateral scales smooth: southern Texas.

**2. Ophisaurus** Daudin. Body snake-like, without legs; eyelids well developed; ear distinct, but small; tail longer than the body: 1 species.

*O. ventralis* (L.). Glass snake. Length 670 mm.; tail 400 mm.; color brown or greenish with a median and 2 lateral stripes; tail very brittle, whence the name of glass snake; to be distinguished from a snake by the eyelids, the ears and the scaly belly: southern and central States; northward into North Carolina, Indiana and Wisconsin; westward to Nebraska and Texas and Mexico; common in dry meadows, where it feeds on insects and worms.

**Family 5. Anniellidæ.**—Elongate, legless lizards with a cylindrical body and no external ear-opening; eye a narrow slit: 1 genus and 2 species.

**Anniella** Gray. With the characters of the family: 2 species.

*A. pulchra* Gray. Length 180 mm.; tail 6 mm .; color gray or brown with 3 dark lines; abdomen yellowish: coastal region of southern California.

**Family 6. Helodermatidæ.**—Large, thick-bodied lizards with brightly colored bodies, covered with small bead-like tubercles; tail short; poison fangs in the lower jaw: 1 genus.

**Heloderma** Wiegmann. With the characters of the family: 2 species.

*H. suspectum* Cope. Gila monster. Body 470 mm. long; tail 120 mm.; color black or purplish, with large, more or less transverse pink or yellowish blotches: deserts of Arizona and New Mexico; the only poisonous lizard in the country or the world.

**Family 7. Xantusiidæ.**—Diminutive, cylindrical lizards with very short legs, and granular scales on the sides and back; belly covered with plates; 3 folds of skin on the throat; eye usually very large and without eyelids; pupil vertical: about 4 species; in desert regions.

**Xantusia** Baird. With the characters of the family: 3 species in the United States.

*X. henshawi* Stejneger. Length 140 mm.; tail 85 mm.; color blackish brown, irregularly marbled with cream-colored lines: southern California.

*X. riversiana* Cope. Length 175 mm.; tail 87 mm.; color gray or brown, spotted with brown or black: San Nicholas, San Barbara and San Clemente Islands.

*X. vigilis* Baird. Length 85 mm.; tail 45 mm.; color gray, yellow or brown, speckled with brown: southeastern California; southern Nevada; common in and beneath fallen yucca trees.

**Family 8. Teiidæ.**—Elongated lizards with a deeply bifid tongue and sometimes rudimentary legs: 1 genus in the United States.

**Cnemidophorus** Wagler. Race runners. Body slender; tail long and tapering; scales granular above, plated beneath: 7 species in the United States.

*C. sexlineatus* (L.). Swift (Fig. 110). Length 250 mm.; tail 175 mm.; color dark brown, with 6 yellow stripes on the body; belly bluish or greenish: Maryland to Florida; westward to Arizona; up the Mississippi Valley to Lake Michigan and Nebraska; common towards the south; remarkable for its swiftness.

*C. gularis* Baird & Girard. Similar to *C. sexlineatus*, but with a row of pale dots between each two stripes: Arkansas and Texas to Arizona.

*C. tessellatus* (Say). Length 450 mm.; tail 300 mm.; color dark olive, with 4 to 7 yellow stripes in the young animal; back marbled

or blotched: in the adult western Texas to California; northward into Colorado and central California; common in dry sandy places.

*C. melanostethus* Cope. Length 315 mm.; tail 230 mm.; color olivaceous, with 12 to 14 longitudinal series of pale spots; tail unicolor, above and below: southern Arizona.

*C. perplexus* B. & G. Length 260 mm.; tail 180 mm.; color olive with 7 pale dorsal stripes; belly unspotted: Texas and New Mexico.

*C. grahami* B. & G. Length 350 mm.; 8 rows of black spots above and on the sides: southern Texas.

**Family 9. Scincidæ.**—Skinks. Small, active lizards with smooth scales underlaid with bony plates; head covered with symmetrical

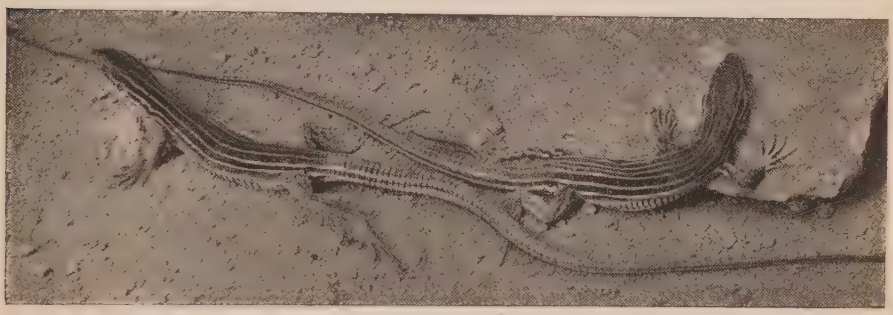


FIG. 110.—*Cnemidophorus sexlineatus* (*from Ditmars*).

plates; tongue free, notched in front; eyelids well developed; pupil round; legs present or absent: about 200 species; cosmopolitan; ovoviviparous; about 14 species in the United States.

### Key to the Genera of Scincidæ

$a_1$ Legs and digits normal.
  $b_1$ Ear-opening denticulate at the anterior margin.....1. *Plestiodon.*
  $b_2$ Ear-opening not denticulate.....2. *Leiolopisma.*
$a_2$ Legs diminutive; toes reduced in number.....3. *Neoseps.*

**1. Plestiodon** Duméril & Bibron (*Eumeces* Wiegmann). Body small, with glossy, shining scales; lower eyelid scaly; palate with teeth: 30 species, in America, Africa and Asia; 12 species in the United States; diurnal; terrestrial.

### Key to the Species of Plestiodon

$a_1$ In the eastern and central States.
  $b_1$ Scales on body in 28 or more rows.
    $c_1$ In the north-central States; back with 4 black stripes..*P. septentrionalis.*

$c_2$ In the eastern, central and southern States; back with 5 yellow dorsal stripes in young.....*P. fasciatus.*
$b_2$ Scales on body in 26 to 28 rows; adult without stripes....*P. obsoletus.*
$b_3$ Scales on body in 24 to 26 rows.
$c_1$ Back with 2 broad black bands.....*P. anthracinus.*
$c_2$ Back with 8 to 10 pale stripes.....*P. multivirgatus.*
$c_3$ Back with 4 green stripes.....*P. pluvialis.*
$b_4$ Scales on body in 22 rows; in Florida.....*P. egregius.*
$a_2$ In Texas and the southwest.
$b_1$ Body without stripes.....*P. guttulatus.*
$b_2$ Back with 4 yellow stripes.....*P. tetragrammus.*
$a_3$ On the Pacific slope.....*P. skiltonianus.*

*P. septentrionalis* Baird. Body stout; tail seven-fourths the length of the body; color light green with 4 dorsal black stripes and a lateral

FIG. 111.—*Plestiodon fasciatus (from Fowler).*

black stripe on each side between 2 white ones: Minnesota, Dakota, Nebraska and Kansas.

*P. fasciatus* (L.) (*P. quinquelineatus* L.). Blue-tailed skink; scorpion (Figs. 99, 111). Length 240 mm.; tail 130 mm.; color black in youth (100 mm.) with 5 dorsal yellow stripes on body and a blue tail, brown or olive in adult males with the stripes faint or absent; head red: Massachusetts to Florida; westward to Arizona; up the Mississippi Valley to Canada; rare and small (150 mm.) towards the north; common in the south.

*P. obsoletus* Baird & Girard. Body large, 300 mm. long; color light olive; young black with 5 faint stripes: Kansas to Utah; southward into Mexico.

*P. anthracinus* Baird. Length 140 mm.; tail 8 mm.; color dark olive green, with 2 light lines on each side between which is a black band; tail bluish: from the Appalachian region to Missouri and Texas; common in the southern mountains.

*P. multivirgatus* Hallowell. Body cylindrical; legs far apart; tail three-halves the length of the body; color pale olive with 4 or 5 stripes on each side: Nebraska to northern Texas.

*P. pluvialis* (Cope). Body small and rather stout with 4 green stripes; belly green: southern Alabama.

*P. egregius* Baird. Body very small and vermiform; legs small and weak; length 100 mm.; color reddish or greenish, with 4 white stripes· southern Florida and the Keys.

*P. guttulatus* (Hallowell). Length 150 mm.; color black in the young with bluish-white spots on the head; adult olive with faint spots; body with 30 rows of scales: Texas to Arizona.

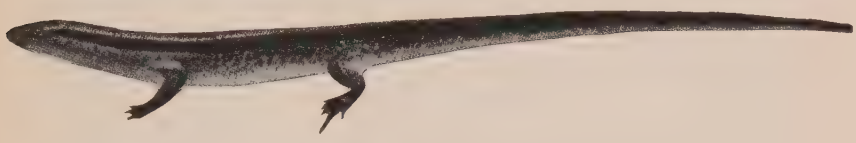


FIG. 112.—*Leiolopisma laterale* (*from Dilmars*).

*P. tetragrammus* Baird. Length 150 mm.; color dark olive with 2 yellowish stripes on each side; body with 26 to 28 rows of scales: Texas.

*P. skiltonianus* B. & G. Length 150 mm.; tail 90 mm.; color olive green, with a dark band bordered by a white line above and below on each side; body with 26 rows of scales: western Oregon to Lower California; common.

**2. Leiolopisma** Duméril & Bibron. Body elongate, small, cylindrical ear-opening very large, exposed; legs very small; lower eyelid with a transparent disk; palate toothless: 28 species, cosmopolitan, 1 in America.

*L. laterale* (Say) (Fig. 112). Length 80 mm.; tail 40 mm.; color olive brown, sometimes irregularly spotted, with a black band edged with white on each side; abdomen yellow; tail blue below: southern New Jersey to Florida, westward to Illinois and Texas; rare in the north, abundant in the south; terrestrial.

**3. Neoseps** Stejneger. Body vermiform; fore leg rudimentary, with a single digit; hind leg very weak, with 2 digits; ear hidden: 1 species.

*N. reynoldsi* Stej. Length 85 mm.; tail 27 mm.; color drab, each scale with a brown spot, these spots forming 4 dark stripes on the back and a broad lateral stripe on each side: Lake County, Florida, burrowing in the ground.

**Family 10. Leposternidæ.**—Vermiform lizards without legs, scales or external ear-opening; teeth pleurodont; eyes concealed; body ringed: 60 species, 1 in the United States.

**Rhineura** Cope. With the characters of the family: 1 species.

*R. floridana* (Baird). Length 220mm.; tail 170mm.; color lavender: Florida; burrowing in soft soil and with the appearance of a large earthworm.

**Order 3. Serpentes.**—Snakes. Very elongate reptiles, covered with horny imbricate scales, and without limbs, tympanum or external ear-opening, or functional eyelids. The bones of the jaws are very loosely articulated with one another and with the cranium, so that the mouth can be stretched to a remarkable degree. The vertebræ are procœlous, giving the body great flexibility, those in front of the anus, except the atlas, all bearing ribs, those back of the anus being without ribs but bearing long transverse processes. Acrodont teeth are always present; in poisonous snakes usually a single pair of maxillary teeth are much elongated and form the poison fangs, of which 3 types are observed in American snakes: 1. Those of the opisthoglyph snakes, belonging to the family *Colubridæ*, in which there are one or more pairs of elongate and grooved but not perforated fangs at the rear of the upper jaw; (2) those of the elaphine snakes, belonging to the family *Elaphidæ*, in which there is a pair of short rigid fangs in the front of the upper jaw, which are perforated by a poison canal and also grooved on the outer surface; and (3) those of the viperine snakes, belonging to the family *Crotalidæ*, in which there is a pair of very long perforated fangs in the front of the upper jaw, which lie against the roof of the mouth when not in action. The tongue is long and forked and protractile; it can be thrust out of the closed mouth, and is an important tactile organ.

The scales are arranged in a definite number of rows, and are either keeled (i.e., with a median longitudinal ridge called the *keel*) or not keeled. The scales on the ventral surface differ in most snakes from those on the dorsal and lateral surfaces, forming a single row of transverse plates called the *ventrals* or *gastrosteges* where they occur in front of the anus, and either a single or a double row called the *subcaudals* or *urosteges* where they lie back of it. The ventrals bear a relation to the ribs and are of assistance in locomotion inasmuch as the animal can move them and thus advance the body over a roughened surface; the ventral immediately in front of the anus is either divided in two or not, and is called the *anal plate*.

**Habits and Distribution.**—Most snakes are oviparous, although many species are ovoviviparous. They feed almost exclusively on live animals or on animals they have recently killed; a few tropical snakes, however, are herbivorous. The poisonous snakes kill their

prey with their poison and the constrictor snakes by crushing before swallowing it; other snakes do not stop to kill the prey but swallow it alive. Snakes live in a great variety of localities, some species

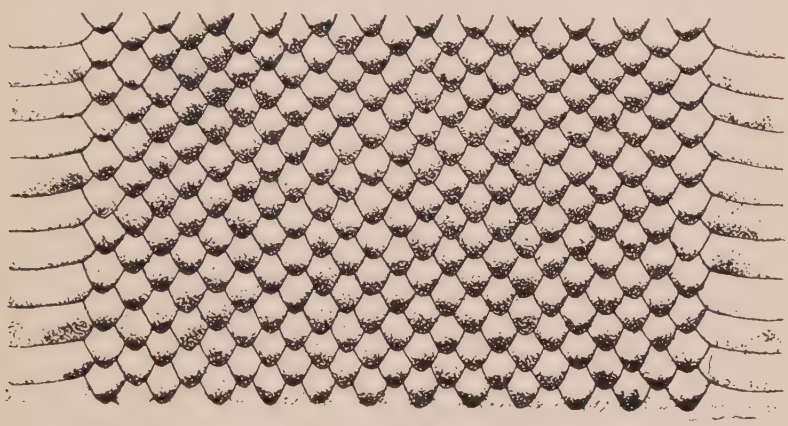


FIG. 113.—A portion of the skin of *Lampropeltis getulus*, showing 23 rows of scales (*from Blanchard*).

being terrestrial, others arboreal; a large number are aquatic, some living in the open sea. Many species are brightly colored, especially in the tropics, but in none has metachrosis, so common among lizards, been observed.

**On the Identification of Snakes.**—The length in millimeters of an average adult specimen from the tip of the snout to the tip of the tail and also the length of the tail alone, are first given, followed by a description of its coloration. Those scales which lack the keel are said to be *smooth*, and these are usually much more glistening than keeled scales, which are dull in appearance. In some snakes only the dorsal scales are keeled, while those of the sides are smooth. The number of rows of scales (Fig. 113) is always important in the description; the number of ventrals is also often important; also the number of subcaudals, and whether a single or a double row is present. Whether the anal plate is single or divided is a very important character (Fig. 114).

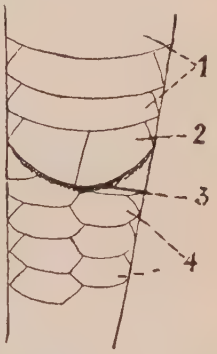



FIG. 114.—A portion of the ventral surface of *Abastor erythrogrammus:* 1, ventrals; 2, anal plate (which is here divided); 3, anus; 4, subcaudals (*from Cope*).

In most species both dorsal and ventral surfaces of the head are covered with symmetrical plates, which are often important in descriptions (Fig. 115).

About 1,800 species of snakes are known, of which 126 species occur in the United States, grouped in 5 families.

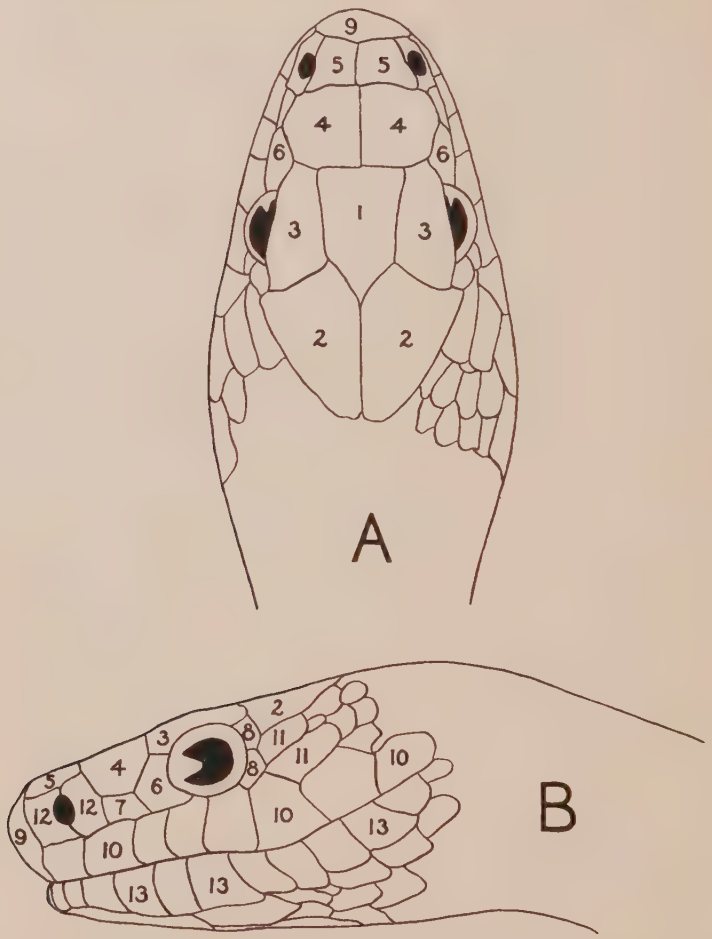



FIG. 115.—Head of snake (*Coluber constrictor*) showing the plates: 1, frontal; 2, parietals 3, supraoculars; 4, prefrontals; 5, internasals; 6, preoculars; 7, loreal; 8, postocular; 9, rostral; 10, upper labials; 11, temporals; 12, nasals; 13, lower labials (*from Hay*).

### Key to the Families of Serpentes

$a_1$ No ventrals present, the belly being covered with scales; eyes covered with scales.....1. *Leptotyphlopidæ.*

$a_2$ Ventrals present; eyes not covered with scales.

$b_1$ No elongate poison fangs in front part of mouth.

$c_1$ Subcaudals undivided, forming a single row.....2. *Boidæ.*

$c_2$ Subcaudals divided, forming 2 rows (except in *Rhinocheilus*).....3. *Colubridæ.*

$b_2$ Elongate poison fangs present in front part of mouth.

c₁ Head not distinct from neck; no pit between eye and nostril.....4. *Elapidæ.*
c₂ Head very distinct; a pit between eye and nostril (Fig. 127).....5. *Crotalidæ.*

**Family 1. Leptotyphlopidæ.**—Small, blind, worm-like snakes with rudiments (not visible) of hind legs and a pelvic girdle: 2 general and species in America.

**1. Leptotyphlops** Fitzinger. Supraocular plates present: several species; 1 in the United States.

*L. dulcis* (Baird & Girard). Length 200 mm.; tail 10 mm.; color pale brown above; white beneath; scales in 14 rows: Texas and New Mexico; burrowing in soft soil, often in ant-hills.

**2. Siagonodon** Peters. Supraocular plates absent: 1 species.

*S. humilis* (Baird & Girard). Body like preceding: Arizona and southern California.

**Family 2. Boidæ.**—The Boas. Mostly large, arboreal constrictor snakes in which rudiments of hind legs and a pelvic girdle are present in form of a pair of spurs near the anus; scales smooth: many species, cosmopolitan; 2 species in the United States, both small. The family includes the boa-constrictors of South America and the pythons of Africa, Asia and the East Indias, which are the largest snakes, reaching a length of 35 feet.

**1. Lichanura** Cope. Form stout; tail obtuse; head covered with scales: several species.

*L. roseofusca* Cope. Length 788 mm.; tail 115 mm.; rows of scales 33 to 42; ventrals 229; subcaudals 49; color bluish gray or brown; abdomen red: southern California and Arizona.

**2. Charina** Gray. Small snakes with very small scales; head covered with plates: 2 species.

*C. bottæ* (Blainville). Rubber snake; ball snake. Length 600 mm.; tail 70 mm.; color brown or gray, yellow beneath; tail very blunt; rows or scales 42 to 47; upper labials 9 to 11; ventrals 200: Nevada and California to Idaho and Washington; common in humid regions, feeding on mice, etc.

**Family 3. Colubridæ.**—Snakes with many conical teeth in both jaws; without poison fangs in the front part of the mouth (but certain genera, the opisthoglyph snakes,[1] are poisonous, one or more pairs of teeth at the rear of the upper jaw being elongate and grooved and forming the poison fangs, such snakes in the United States, however,

[1] The opisthoglyph genera in the United States are the following: *Sonora, Hypsiglena, Tantilla, Trimorphodon.*

being too small to be dangerous); top of head covered with symmetrical plates; a single row of ventrals and usually a double row of subcaudals present; no rudimentary hind limbs; eyes well developed: 1,300 species, in all the tropical and temperate regions of the world; over 100 species in the United States.

### Key to the United States Genera of Colubridæ

$a_1$ Scales keeled.
  $b_1$ Snout turned up at the end..... 5. *Heterodon.*
  $b_2$ Snout flattened and truncated at the end..... 9. *Phyllorhynchus.*
  $b_3$ Snout normal.
    $c_1$ Anal plate divided.
      $d_1$ Color bright green..... 7. *Opheodrys.*
      $d_2$ Color not green.
        $e_1$ Scales in 15 to 17 rows; size small.
          $f_1$ No loreal present.....28. *Storeria.*
          $f_2$ Loreal present; no preocular.
            $g_1$ One internasal present.....29. *Potamophis.*
            $g_2$ Two internasals present.....30. *Amphiardis.*
        $e_2$ Scales in 19 or more rows.
          $f_1$ Ventrals 200 or more; belly flattened, with a ridge along each side.....11. *Elaphe.*
          $f_2$ Ventrals less than 165.....25. *Natrix.*
    $c_2$ Anal plate single.
      $d_1$ One nasal present on each side.....27. *Tropidoclonion.*
      $d_2$ Two nasals present on each side.
        $e_1$ Scales in 19 to 21 rows; garter snakes.....32. *Thamnophis.*
        $e_2$ Scales in 25 or more rows; size large.....13. *Pituophis.*
$a_2$ Scales smooth.
  $b_1$ Anal plate divided.
    $c_1$ Scales in 13 rows.
      $d_1$ In the central and eastern States..... 1. *Carphophis.*
      $d_2$ On the Mexican border.....24. *Chilomeniscus.*
    $c_2$ Scales in 15 to 17 rows.
      $d_1$ Color black, with a yellow collar; size small.... 4. *Diadophis.*
      $d_2$ Without such markings.
        $e_1$ Color pale green; size small..... 6. *Liopeltis.*
        $e_3$ Color not green.
          $f_1$ Size large; ventrals 180 to 200.
            $g_1$ Snout truncated; 3 longitudinal stripes. 8. *Salvadora.*
            $g_2$ Snout not truncated; mostly without stripes or spots.....10. *Coluber.*
          $f_2$ Size medium or small; ventrals 125 to 160.
            $g_1$ Ventrals about 125.
              $h_1$ Upper labials 6.....31. *Virginia.*
              $h_2$ Upper labials 7.
                $i_1$ In the southeastern States.....15. *Leimadophis.*

$i_2$ On the Mexican border.....23. *Ficimia.*
$g_2$ Ventrals 150 to 160.
$h_1$ On the Pacific slope.....18. *Contia.*
$h_2$ In the south and southwest.
$i_1$ Color black; in Florida.....26. *Seminatrix.*
$i_2$ Color uniform brown.....34. *Tantilla.*
$i_3$ Color gray or pale brown, sometimes banded.....19. *Sonora.*
$c_3$ Scales in 19 rows; in the southern States.
$d_1$ Two internasals present..... 2. *Abastor.*
$d_2$ One internasal present.
$e_1$ Body tapering abruptly at both ends.....33. *Liodytes.*
$e_2$ Body not tapering abruptly at the ends..... 3. *Farancia.*
$c_4$ Scales in 21 rows; pupil vertical.
$d_1$ One row of brown spots on the back.....22. *Hypsiglena.*
$d_2$ Two rows of brown spots on the back.....35. *Trimorphodon.*
$c_5$ Scales in 25 to 29 rows.....11. *Elaphe.*
$b_2$ Anal plate single.
$c_1$ A single row of subcaudals present.....21. *Rhinocheilus.*
$c_2$ A double row of subcaudals present.
$d_1$ Scales in 17 rows; size large.....12. *Drymarchon.*
$d_2$ Scales in 19 to 25 rows.
$e_1$ Upper labials 7; size large.....16. *Lampropeltis.*
$e_2$ Upper labials 6; size small.
$f_1$ Lower labials 8.....20. *Cemophora.*
$f_2$ Lower labials 5.....17. *Stilosoma.*
$d_3$ Scales in 29 to 31 rows.....14. *Arizona.*

**1. Carphophis** Gervais. Small, non-poisonous snakes without a distinct neck and with a pointed snout; no preocular; colors uniform: 2 species; terrestrial and burrowing.

*C. amœnus* (Say). Ground snake (Fig. 116). Length 260 mm.; tail 45 mm.; color brown above, pink below; eyes very small; ventrals about 128: Connecticut to Florida; westward to Illinois; often common, but secretive and rarely seen.

FIG. 116.—*Carphophis amœnus* (*from Cope*).

**2. Abastor** Gray. Large, brightly colored snakes with head not distinct from body; no preocular; ventrals about 180; upper labials 7: 1 species.

*A. erythrogrammus* (Daudin). Rainbow snake (Fig. 114). Length 1,200 mm.; tail 160 mm.; color blue-black, with 3 longitudinal red stripes; abdomen red, with 2 rows of black blotches: Virginia to the Gulf, in the coastal plain, in swampy, wooded places; burrowing; common.

**3. Farancia** Gray. Large, brightly colored snakes with indistinct head; no preocular; upper labials 7; ventrals about 172: 1 species.

*F. abacura* (Holbrook). Horn snake; mud snake. Length 1,250 mm.; tail 160 mm.; color blue-black, with a series of large red spots on each side; abdomen red, blotched with black; a horny spine at the end of the tail: Atlantic and Gulf States from Virginia to Louisiana, and up the Mississippi Valley into Indiana; in wet woods, burrowing under logs and in the sand; common in the south.

**4. Diadophis** Baird & Girard. Ring-neck snakes. Small snakes with a flattened head and a yellow ring around the neck: 4 species; terrestrial, burrowing, feeding on earthworms, etc.

**Key to the Species of Diadophis**

$a_1$ Scales in 15 rows.
  $b_1$ In the eastern States.....*D. punctatus.*
  $b_2$ On the Pacific slope.....*D. amabilis.*
$a_2$ Scales in 17 rows.
  $b_1$ In the central States.....*D. arnyi.*
  $b_2$ Along the Mexican border.....*D. regalis.*

*D. punctatus* (L.) Length 330 mm.; tail 70 mm.; color dark gray or black, with a yellow collar; belly orange, sometimes with black spots; ventrals about 155: United States east of the Mississippi; common.

*D. arnyi* Kennicott. Length 310 mm.; tail 50 mm.; color dull black, with a narrow yellow collar; belly yellowish, spotted with black; body slender: Ohio to Iowa, and southward into Texas; common.

*D. amabilis* B. & G. Length 430 mm.; tail 90 mm.; color bluish or greenish-black with a reddish collar; belly reddish: Oregon to Lower California; common.

*D. regalis* B. & G. Length 600 mm.; color dark bluish-gray above; belly yellow or reddish, with many small black spots; coloration sometimes faint or absent: Texas to Arizona.

**5. Heterodon** Latreille. Hog-nosed snakes (Fig. 117). Moderate sized snakes with a broad, upturned snout (rostral plate) and an extra plate (the azygous) back of the rostral; scales in 23 to 25 rows; ventrals about 140; upper labials 8: 4 species, all in the eastern and central States; terrestrial, feeding on toads and insects and burrowing with the peculiar snout; when alarmed they dilate and flatten the neck and head while hissing loudly, and often throwing themselves into contortions or feigning death; they are harmless.

**Key to the Species of Heterodon**

$a_1$ No accessory scales around the azygous plate; scales in 25 rows...*H. contortrix.*
$a_2$ Accessory scales around the azygous plate.
  $b_1$ Scales in 25 rows.....*H. simus.*
  $b_2$ Scales in 23 rows.....*H. nasicus.*

*H. contortrix* (L.) (*H. platyrhinus* Latreille) (Fig. 117). Puffing or spreading adder; blowing viper. Length 700 mm.; color brown or reddish, with about 28 dark or black dorsal patches between the head and tail, and a series of similar patches on each side alternating irregularly with them; on the tail the blotches tend to form rings around the body; belly yellowish, blotched on the edges with black; a melanistic variety occurs which is plain black: eastern States, south of New Hampshire and Minnesota; westward to the Great Plains; common, especially in dry, sandy places.

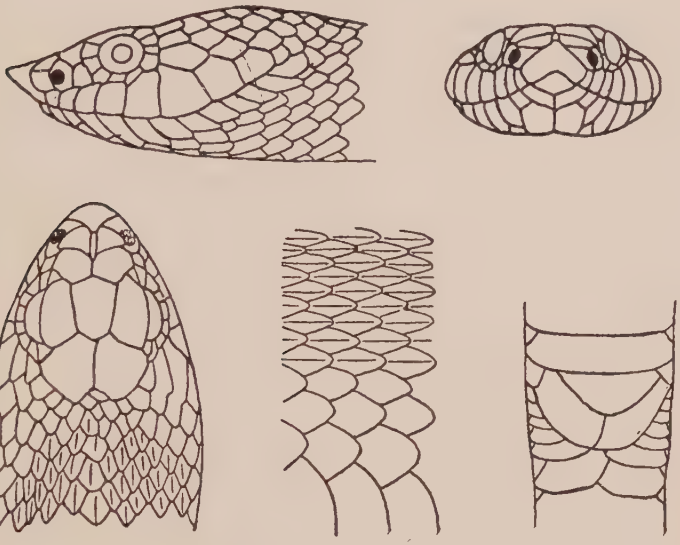


FIG. 117.—*Heterodon contortrix* (*from Cope*).

*H. nasicus* Baird & Girard. Length 660 mm.; tail 70 mm.; color gray or light brown, with a dorsal and 2 lateral series on each side of small darker spots, which on the tail tend to form rings; center of abdomen black: western States from Dakota and Montana into Mexico; common in Texas and the south.

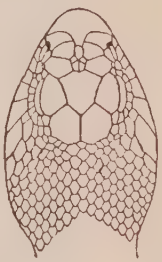


FIG. 118. *Heterodon simus* (*from Cope*).

*H. simus* (L.) (Fig. 118). Length 470 mm.; tail 80 mm.; color gray or brownish with about 35 dark brown dorsal patches alternating with smaller ones on each side; belly yellowish: southeastern States, from South Carolina to the Mississippi, and northward in its valley into Indiana; less common than *H. contortrix*.

**6. Liopeltis** Fitzinger. Small, green snakes with smooth scales in 15 rows; upper labials 7; ventrals 135: several species in eastern Asia, 1 in America.

*L. vernalis* (Harlan). Green snake; grass snake. Length 400 mm.; tail 130 mm.; color uniform green, lighter underneath: eastern, western and central States; westward to New Mexico; common towards the north; terrestrial, living in the grass and in shrubbery, and feeding on insects.

**7. Opheodrys** Fitzinger (*Cyclophis* Gunther). Small, green snakes with keeled scales in 17 rows; upper labials 7; ventrals 155: several species in Asia, 1 in America.

*O. æstivus* (L.) Green snake. Length 840 mm.; tail 320 mm.; color uniform green; belly yellow: southern New Jersey to the Gulf; westward to New Mexico and northward in the Mississippi Valley to Illinois and Kansas; common; arboreal, feeding on insects.

**8. Salvadora** Baird & Girard. Slender ground snakes with a snout surmounted by a triangular rostral shield, giving it a truncated appearance in front; scales smooth and in 17 rows; upper labials 8: several species in Mexico, 1 in the United States.

*S. grahamiæ* B. & G. Patch-nose snake. Length 700 mm.; tail 100 mm.; back with a broad yellow middorsal stripe, bordered on each side by a dark brown stripe of equal width, beneath which is a light brown band; belly yellow; ventrals about 180: western Texas to California; common, especially in rocky places.

**9. Phyllorhynchus** Stejneger. Small slender snakes with a large triangular rostral shield giving the snout a truncated appearance; anal plate single; scales in 19 rows and imperfectly keeled; upper labials 6: 2 species.

*P. browni* Stej. Length 325 mm.; tail 42 mm.; color whitish, with 15 brown blotches on the back; belly white; scales keeled on the hinder two-thirds of the body and very faintly keeled on the forward third: southern Arizona.

**10. Coluber** L. (*Zamenis* Wagler). Blacksnakes; racers. Large, non-venomous snakes with head distinct from the neck; scales smooth, in 15 or 17 rows; upper labials 7 or 8: many species in the New and Old Worlds, 6 in the United States; active snakes which live on the ground but can also climb bushes and trees, feeding on small mammals, reptiles and frogs; they do not constrict their prey but may kill it by pressing it against the ground.

**Key to the Species of Coluber**

$a_1$ Body never striped.

$b_1$ Color black, bluish or olive..... *C. constrictor.*

b$_2$ Color brown, at least posteriorly ..... C. *flagellum.*
a$_2$ Body striped.
b$_1$ A yellow stripe on each side ..... *C. lateralis.*
b$_2$ Four or five stripes on each side ..... *C. tæniatus.*

*C. constrictor* L. Blacksnake; bluè racer; hoop snake (Fig. 115). Body slender; length 1,700 mm.; tail 449 mm.; greatest length 2,200 mm.; color slaty or blue-black above, greenish black to yellow beneath; chin and throat white; ventrals about 180; young animals (500 mm. long) gray in color with dorsal transverse bars and lateral spots: entire country.

*Subspecies of C. constrictor*

*C. c. constrictor* L. Belly black: eastern and central States; westward to the Great Plains; common.

*C. c. flaviventris* Say. Belly yellow: from the Mississippi to the Pacific; common.

*C. flagellum* Shaw. Whip snake. Body very slender, 2,000 mm. long; tail 500 mm.; color yellowish brown to dark brown, being darker anteriorly; abdomen white or yellow, more or less blotched with brown anteriorly; ventrals about 190; young animals with dorsal blotches: southern States from Virginia to California; common.

*C. lateralis* (Hallowell). Length 665 mm.; tail 250 mm.; color brown above with a yellow stripe on each side, yellow below; head somewhat spotted; ventrals about 200: southern California.

*C. tæniatus* (Hallowell). Body very slender, 1,280 mm. long; tail 400 mm.; color black, with many yellow lines on the sides; belly white, but pink on the tail; throat spotted with black: Idaho and Utah, southward to Texas and southern California; often common.

**11. Elaphe** Wagler (*Coluber* Aut.). Large, non-venomous snakes with a flat, blunt head; dorsal scales with slight keels; lateral scales smooth; scales in 25 to 29 rows: about 20 species in North America and Europe and Asia; 8 species in the United States.

**Key to the Species of Elaphe**

a$_1$ Body striped; no spots ..... *E. quadrivittata.*
a$_2$ Body uniform in color or spotted.
b$_1$ Scales smooth or with a few rows of dorsal scales weakly keeled.
c$_1$ Neck spots H-shaped ..... *E. læta.*
c$_2$ Neck spots not H-shaped ..... *E. guttata.*
b$_2$ Scales with at least 9 dorsal rows keeled.
c$_1$ Body spotted or blotched.

$d_1$ Neck spots H-shaped.....*E. o. confinis.*
$d_2$ Neck spots not H-shaped.....*E. vulpina.*
$c_2$ Body uniform black.....*E. o. obsoleta.*

*E. quadrivittata* (Holbrook). Chicken snake. Length 1,500 mm.; tail 300 mm.; color yellow or light brown, with 4 dark brown or black stripes; scales in 27 rows: southeastern and Gulf States, from North Carolina to the Mississippi River; arboreal; often around chicken houses, where they feed on rats, young chickens and eggs.

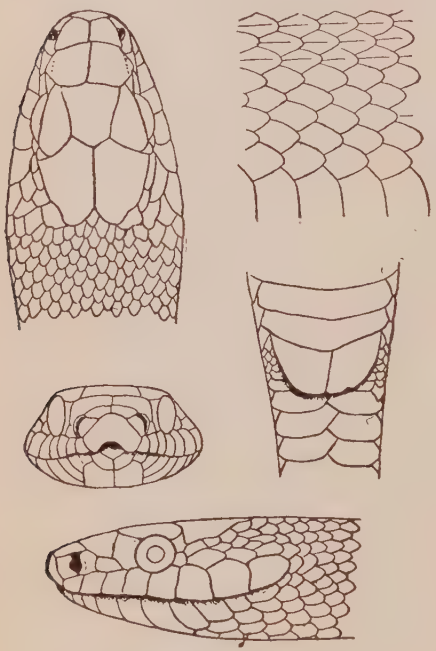


FIG. 119.—*Elaphe obsoleta (from Cope).*

*E. læta* (Baird & Girard) (*Coluber emoryi* B. & G.). Length 800 mm.; tail 160 mm.; color gray, with a dorsal series of large rectangular brown blotches alternating with 2 more or less distinct smaller series on each side: Missouri and Kansas to Mexico; common towards the south.

*E. guttata* (L.). Corn-snake. Length 1,000 mm.; tail 160 mm.; greatest length 1,750 mm.; color reddish or yellowish brown, with a dorsal series of about 54 large red, black-bordered blotches; belly white, with black spots: south Atlantic and Gulf States from Maryland to Louisiana; common.

*E. obsoleta* (Say) (Fig. 119). Length 1,800 mm.; tail 300 mm.; greatest length 2,400 mm.; color black to gray, with the edges of the scales often yellow, and often a series of large dark dorsal blotches; throat white; belly dark, more or less blotched: Massachusetts to the Gulf; westward to Illinois and Texas.

*Subspecies of E. obsoleta*

*E. o. obsoleta* (Say). Pilot blacksnake. Color uniform black: northern States.

*E. o. confinis* (B. & G.). Color gray, with large, irregular dark dorsal spots and smaller lateral spots: south Atlantic and Gulf States; Missouri.

*E. vulpina* (B. & G.). Fox-snake. Length 1,150 mm.; tail 200 mm.; color brown or yellowish, with a series of dark brown blotches which alternate with a lateral series on each side; belly yellow, with dark spots; head often reddish: Ohio to Minnesota; southward to the Missouri; often common, feeding on rats round barns; they often emit a fox-like odor.

**12. Drymarchon** Fitzinger (*Spilotes* Wagler). Large tropical, non-poisonous snakes with a simple anal plate and smooth scales; upper labials 8; color shining black, above and below: 1 species.

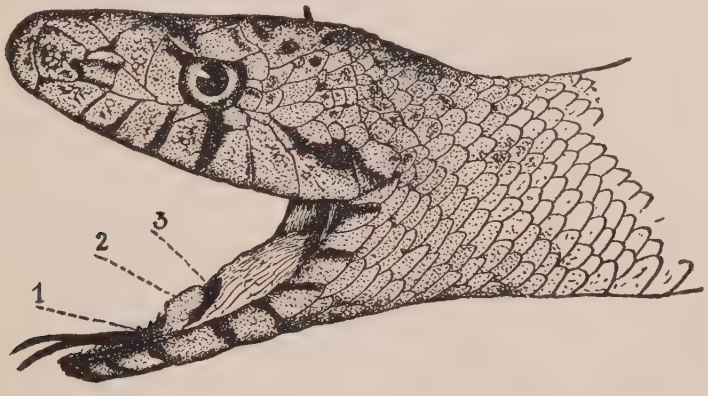



FIG. 120.—*Pituophis sayi:* 1, sheath of tongue; 2, epiglottis; 3, glottis (*from Cope*).

*D. corais couperi* (Holbrook). Indigo snake; gopher snake. Length 2,300 mm.; tail 330 mm.; scales in 17 rows: Gulf States; northward into South Carolina; westward to Texas; one of the largest American snakes; often round barns and houses, looking for rats and mice.

**13. Pituophis** Holbrook. Bull-snakes. Large, non-poisonous, constrictor snakes with a long pointed head; scales in 25 to 35 rows; dorsal scales keeled, lateral scales smooth; ventrals about 215; upper labials 8 or 9; a peculiar epiglottis-like membrane (Fig. 120) in front of the glottis vibrates when the animal is alarmed, producing a loud hiss: 4 species, all American; the largest American, harmless snakes; terrestrial and arboreal, feeding on small mammals, birds and eggs, and living usually in dry woods.

**Key to the Species of Pituophis**

$a_1$ In the eastern States.....*P. melanoleucus.*
$a_2$ In the prairie States and Great Plains.....*P. sayi.*
$a_3$ On the Pacific slope.....*P. catenifer.*

*P. melanoleucus* (Daudin). Pine snake. Length 1,500 mm.; tail 220 mm.; greatest length 2,400 mm.; color whitish, with a series

of from 27 to 33 large, black or brown, irregular dorsal blotches and 2 series of smaller lateral blotches on each side; belly white: southern New Jersey to the Gulf; often abundant in pine woods.

*P. sayi* (Schlegel) (Fig. 120). Length 1,550 mm.; tail 200 mm.; greatest length 2,600 mm.; color reddish yellow, with a series of large, square brown or black dorsal blotches, and a series of smaller blotches on each side; abdomen yellow, with a row of black spots on each side: prairie States between the Mississippi River and the Rockies; very common towards the south; the largest American snake.

*P. catenifer* (Blainville). Length 1,400 mm.; tail 240 mm.; color yellowish brown, with a series of about 100 small square, reddish brown or black dorsal spots and a series of more or less obscure spots on each side; belly yellowish white with 2 series of spots: Pacific slope west of the Sierra Navada and the Cascades; desert regions of southern California and Nevada; common.

**14. Arizona** Kennicott. Large snakes with a rostral plate recurved and extending between the internasals; scales smooth; anal plate single: 2 species.

*A. elegans* Kenn. Length 918 mm.; tail 145 mm.; color grayish brown, crossed by 55 to 65 transverse brown spots in front of the anus; belly whitish, unspotted; scales in 29 to 31 rows: along the Mexican border; northward into Oklahoma and Arkansas.

**15. Leimadophis** Fitzinger. Small snakes with smooth scales in 17 rows; ventrals 125; upper labials 7: many species in Mexico and Central America, 1 in the United States.

*L. flavilatus* (Cope). Length 300 mm.; tail 90 mm.; color golden brown; abdomen yellowish white: North Carolina to Florida; terrestrial.

**16. Lampropeltis** Fitzinger. King-snakes. Non-poisonous, constrictor snakes with smooth scales in 19 to 27 rows; colors often bright, arranged usually in transverse bands: about 12 species, all American, 9 in the United States; terrestrial, feeding on rodents and other small animals, including snakes, being immune to the bites of poisonous ones.

**Key to the Species of Lampropeltis**

$a_1$ Ground color black, with usually narrow transverse color bands ..... *L. getulus.*

$a_2$ Ground color pale, with large, red or brown blotches.

$b_1$ Blotches wide and long, making up most of the color pattern ..... *L. triangulum.*

$b_2$ Blotches small, oblong.

$c_1$ Scales in 23 rows ..... *L. rhombomaculata.*

$c_2$ Scales in 25 rows.....*L. calligaster.*
$a_3$ Color pattern contains color rings encircling body.
$b_1$ Ground color red; rings black.....*L. elapsoides.*
$b_2$ Ground color red; rings whitish.....*L. pyrrhomelana.*
$b_3$ Ground color white; rings black.....*L. multicincta.*

*L. getulus* (L.). Chain-snake (Fig. 113). Length 1,500 mm.; tail 200 mm.; greatest length 1,800 mm.; color black, with usually narrow yellow or white dorsal bands which may fork on the sides and join one another, giving the effect of a chain; belly black, blotched with white or yellow; scales in 21 to 25 rows; superior labials 7: entire country south of latitude 40; common.

*Subspecies of L. getulus*

*L. g. getulus* (L.). Color bands narrow, forking on the sides; scales in 21 rows: New Jersey to the Gulf.

*L. g. holbrooki* Stejneger. Scales in 21 rows; a yellow spot on each dorsal scale; no bands: Louisiana to Texas; northward to Illinois and Wyoming.

*L. g. nigra* (Yarrow). Scales in 21 rows; scales without light centers or with very small ones: eastern Illinois to Ohio; southward into Alabama.

*L. g. floridana* Blanchard. Scales in 23 rows; cross bands more than 50, or not distinguishable: Florida.

*L. g. boyli* (Baird & Girard). Scales in 23 rows; color bands broad and forming rings: western Arizona and Utah to California.

*L. g. californiæ* (Blainville). Scales in 23 rows; a dorsal longitudinal stripe either complete or interrupted: southern California.

*L. triangulum* (Lacépède) (*L. doliata* L.). Length 860 mm.; tail 130 mm.; ground color gray or yellow, with a series of broad, black-bordered red or brown bands or saddles occupying the dorsal and lateral sides of the body; abdomen yellowish or red, with black spots alternating irregularly with the bands; scales in 21 rows: eastern and central States; westward into Texas, Kansas and Iowa; often common.

*Subspecies of L. triangulum*

*L. t. syspila* (Cope). Dorsal saddles 23 to 35 in number: Ohio and Tennessee to Iowa and Oklahoma.

*L. t. triangulum* Lac. Milk-snake. Ground color gray, bands much broken and brown or reddish: northern States; southward into North Carolina; westward into Iowa.

*L. t. amaura* Cope. Scarlet king-snake. Ground color yellow; bands bright red, nearly encircling the body and about 20 in number: Mississippi to Texas.

*L. t. gentilis* (B. & G.). Bands dull red with black borders and 25 to 40 in number: Texas to Dakota.

*L. rhombomaculata* (Holbrook). Length 830 mm.; tail 111 mm.; color light brown, with a series of about 55 chestnut lenticular dorsal blotches, alternating with a series of smaller blotches on each side; belly yellowish, more or less blotched; scales in 21 rows: Maryland to northern Florida.

*L. calligaster* (Say). Length 1,150 mm.; tail 160 mm.; color gray or light brown, with a series of about 60 squarish, brown black-bordered blotches and 2 series of smaller blotches on each side; scales in 25 rows: Indiana to Minnesota; southward to Texas.

*L. elapsoides* (Holbrook). Scarlet snake. Length 430 mm.; tail 67 mm.; color bright red, with about 18 pairs of black rings encircling the body, each pair enclosing a white ring; scales in 19 rows: southeastern and Gulf States, from Maryland to Louisiana.

*L. pyromelana* (Cope). Length 725 mm.; tail 102 mm.; color yellowish or red, forming about 38 broad bands encircling the body which are separated by as many narrow yellowish bands each bordered with black; scales in 23 rows; labials 7: southern New Mexico to California.

*L. multicincta* (Yarrow). Coral king-snake. Length 850 mm.; tail 147 mm.; color pattern formed of about 45 black rings encircling the body, each ring enclosing some red, and separated by narrower whitish rings; head black; scales usually in 23 rows: California, except in deserts.

**17. Stilosoma** Brown. Slender snakes with smooth scales in 19 rows; head not distinct from the body; no loreals: 1 species.

*S. extenuatum* Brown. Length 532 mm.; tail 50 mm.; color silver-gray, with 61 dorsal dark brown spots on the body and 11 on the tail; belly gray, blotched with black: north-central Florida.

**18. Contia** Baird & Girard. Small snakes with smooth scales in 15 rows; ventrals about 150; upper labials 7: several species, 1 in the United States.

*C. tenuis* (B. & G.). Length 290 mm.; tail 60 mm.; color deep chestnut brown, with 2 light longitudinal bands; yellow below with dark bars: Puget Sound to southern California; rare.

**19. Sonora** Baird & Girard. Small poisonous snakes with smooth scales in 13 to 15 rows; rear maxillary teeth elongate and grooved; ventrals about 160; upper labials 7: 4 species.

**Key to the Species of Sonora**

$a_1$ Scales in 13 rows.....*S. taylori.*
$a_2$ Scales in 15 rows.
  $b_1$ Ventrals 145 to 153; subcaudals 35 to 57.
    $c_1$ From southern Texas to southeastern California.....*S. episcopa.*
    $c_2$ From Nevada to southern Kansas.....*S. semiannulata.*
  $b_2$ Ventrals 158; subcaudals 34.....*S. occipitalis.*

*S. taylori* (Boulenger). Length 270 mm.; tail 55 mm.; color pale brown above, white beneath: southern Texas.

*S. episcopa* (Kennicott). Color ashen to rosy, usually with a rosy vertebral stripe; belly uniform whitish green; ventrals 163: Texas to southeastern California.

*S. semiannulata* B. & G. Length 230 mm.; tail 40 mm.; color ashen or pink, crossed by about 20 black half rings; belly white: southern Kansas to Nevada and Arizona.

*S. occipitalis* (Hollowell). Length 323 mm.; tail 53 mm.; color milk white above, with 34 transverse black bands; belly white: Colorado to southeastern California.

**20. Cemophora** Cope. Small, harmless snakes with smooth scales in 19 rows; ventrals about 170; upper labials 6: 1 species.

*C. coccinea* (Blumenbach). Length 410 mm.; tail 60 mm.; color scarlet, with about 20 pairs of black cross bands, each pair enclosing a yellow band; belly white or yellow; top of head red or orange: southern and Gulf States from Maryland to the Mississippi; common in Florida; very similar in appearance to the poisonous coral snakes, but differing from them in having a plain, unblotched belly; similar also to the scarlet king-snake which differs from it in that its rings nearly encircle the body.

**21. Rhinocheilus** Baird & Girard. Small snakes with smooth scales in 23 rows and undivided subcaudals: 1 species.

*R. lecontei* B. & G. Length 600 mm.; tail 85 mm.; color black and red, there being 33 large square black blotches alternating with red bands; belly white: western Kansas and Texas into California.

**22. Hypsiglena** Cope. Small poisonous snakes with smooth scales in 21 rows; rear teeth in upper jaw enlarged and grooved; pupil vertical: 1 species.

*H. ochrorhynchus* Cope. Length 675 mm.; tail 75 mm.; color gray with about 48 large brown spots on the body and 2 alternating series on the tail; 2 lateral series; ventrals 167; subcaudals 55: western Texas to southeastern California.

**23. Ficimia** Gray. Small, stout snakes with an acute rostral plate, the anterior end of which is turned up; no loreal plate; scales smooth, in 17 rows; anal plate divided; pupil round: 2 species.

*F. cana* (Cope). Length 188 mm.; tail 23 mm.; color brownish yellow, with 30 cross bands; belly whitish, unspotted; upper labials 7: western Texas to Arizona.

**24. Chilomeniscus** Cope. Small, stout burrowing snakes with a prominent rounded, flattened snout; scales smooth, in 13 rows; anal plate divided; no loreal plate: 1 species.

*C. ephippicus* Cope. Length 120 mm.; tail 16 mm.; color red or orange, with 21 black cross bars in front of the anus; belly white: southern Arizona and California.

**25. Natrix** Laurenti (*Tropidonotus* Kuhl). Water snakes. Thick-bodied non-poisonous snakes with a distinct head and with keeled scales in from 19 to 33 rows; ventrals about 140; colors brown or black: many species in North America and Eurasia, all viviparous and semi-aquatic, living along the borders of streams or ponds and feeding on frogs, fish and other cold blooded animals.

**Key to the United States Species of Natrix**

$a_1$ Body striped longitudinally.
  $b_1$ Scales in 19 rows; upper labials 7.
    $c_1$ Abdomen with 2 brown stripes; eastern States.....*N. septemvittata.*
    $c_2$ Abdomen with 2 rows of black spots; southeastern States.....*N. rigida.*
    $c_3$ Abdomen plain or with a central black stripe; central States.....*N. grahami.*
  $b_2$ Scales in 21 rows; Gulf States.....*N. clarki.*
$a_2$ Body with transverse bands or spots, sometimes plain.
  $b_1$ Scales in 19 rows; in the central States.....*N. kirtlandi.*
  $b_2$ Scales in 21 rows; Florida.....*N. compressicauda.*
  $b_3$ Scales in 23 to 25 rows; eastern and central States.....*N. sipedon.*
  $b_4$ Scales in 27 rows; Mississippi Valley.....*N. rhombifera.*
  $b_5$ Scales in 29 to 33 rows.
    $c_1$ Back with many narrow cross bands.....*N. cyclopion.*
    $c_2$ Back with large square blotches.....*N. taxispilota.*

*N. septemvittata* (Say). Moon-snake; queen-snake. Length 600 mm.; tail 120 mm.; color dark brown, with 3 narrow, black dorsal stripes, often indistinct, and a bright yellow lateral band; belly yellow, with 2 brown bands: United States east of the Mississippi, except New England and New York; common.

*N. rigida* (Say). Length 560 mm.; tail 120 mm.; color brown, with 2 narrow black stripes; belly yellow, with 2 stripes or rows of black spots: extreme southeast.

*N. grahami* (Baird & Girard). Length 640 mm.; tail 120 mm.; color brown with a pale middorsal band and a broad pale or yellow lateral band bordered beneath with black; belly plain yellowish: Mississippi Valley, from the Great Lakes to Texas; common.

*N. clarki* (B. & G.). Length 790 mm.; tail 178 mm.; color brown, with 4 bands of deep brown; belly yellow, with 2 brown bands dotted with black: coastal regions from Florida to Texas.

*N. kirtlandi* (Kennicott). Length 400 mm.; tail 100 mm.; color light brown or reddish, with 2 series of rather indistinct round spots on the back alternating with a series of large black blotches on each side; belly red in the middle portions, with a row of dark spots on each side;

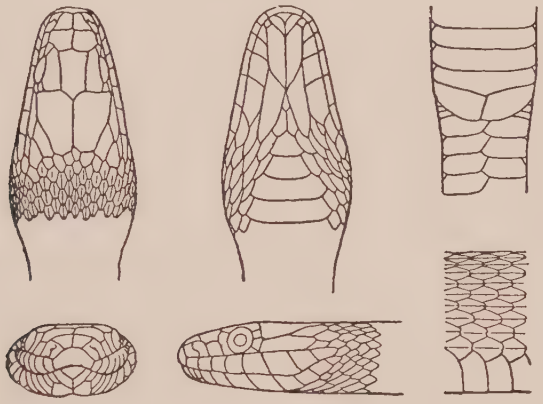


FIG. 121.—*Natrix sipedon (from Cope).*

upper labials 6: north-central States, from Wisconsin to Pennsylvania and New York; common.

*N. compressicauda* (Kennicott). Length 560 mm.; tail 130 mm.; color gray, with irregular, obscure darker bands; belly gray or brown, with a central series of yellow spots; tail flattened at base: southwestern Florida.

*N. sipedon* (L.) (*N. fasciata* L.). Common water snake (Fig. 121). Length 960 mm.; tail 200 mm.; color brown, with 30 or 40 yellowish or reddish, often indistinct transverse bars which may widen on the sides; belly yellowish or white, with many brown or red spots; scales in 23 or 25 rows: eastern and central States; westward into Colorado.

### *Subspecies of N. sipedon*

*N. s. sipedon* (L.). Bands broken into blotches on latter part of body, old animals uniform brown: Canada to North Carolina; westward to Kansas.

*N. s. fasciata* (L.). A series of lateral vertical, oblong red spots; belly yellowish or reddish, more or less spotted: Atlantic coast from Virginia southward; westward to Louisiana and up the Mississippi Valley to Nebraska and Indiana.

*N. s. transversa* (Hallowell). Dorsal bands broken into blotches the entire length of body: Texas, Arkansas and Oklahoma.

*N. rhombifera* (Hallowell). Length 1,000 mm.; tail 240 mm.; color brownish, with a series of about 50 dorsal rhomboidal blotches; scales in 27 rows: southern Indiana and Illinois to Louisiana and Texas.

*N. cyclopion* (Duméril & Bibron). Length 1,000 mm.; tail 260 mm.; color dark greenish with many dorsal transverse black bands; eye surrounded by a ring of scales; scales in 29 rows: Florida to Louisiana and up the Mississippi Valley to southern Illinois.

*N. taxispilota* (Holbrook) Water-pilot. Length 1,300 mm.; tail 300 mm.; color rusty brown, with a series dark blotches on the back alternating with a similar series on each side; scales in 29 to 33 rows: Atlantic and Gulf States; northward to North Carolina; the largest American water snake.

FIG. 122.—*Storeria dekayi (from Cope).*

**26. Seminatrix** Cope. Small snakes living in or near the water, with smooth scales in 17 rows; scales on the tail weakly keeled; upperlabials usually 8: 1 species.

*S. pygæa* (Cope). Length 420 mm.; tail 70 mm.; color black, with a faint pale line running along the center of each scale; belly red, crossed on the body with narrow black bars; anal plate divided: Florida.

**27. Tropidoclonion** Cope. Small snakes with keeled scales in 19 rows; upper labials 6; ventrals about 140: 1 species.

*T. lineatum* (Hollowell). Length 360 mm.; tail 40 mm.; color grayish brown, with a light middorsal stripe; belly whitish, with 2 rows of black spots: central States from Ohio to South Dakota; southward to Texas; common in wet places and swamps.

28. **Storeria** Baird & Girard. Small snakes with head distinct from the neck and with scales in 15 to 17 rows; ventrals about 135; loreal plate absent: 4 species, all American and viviparous; 3 species in the United States.

*S. dekayi* (Holbrook). Dekay's snake; brown snake (Fig. 122). Length 300 mm.; tail 60 mm.; color chestnut or grayish brown, with a lighter middorsal stripe bordered with black dots; belly whitish; upper labials 7; scales in 17 rows: eastern and central States; westward to Kansas; southward into Mexico; terrestrial, secretive, living under stones and logs, often in towns, feeding on insects, worms, etc.; common.

*S. occipitomaculata* (Storer). Red-bellied snake. Length 250 mm.; tail 60 mm.; color chestnut brown or grayish with a lighter middorsal stripe bordered with dark dots; belly red; upper labials 5 or 6; scales in 15 rows: eastern and central States; westward to Kansas; southward into Mexico.

**29. Potamophis** Fitzinger (*Haldea* Baird & Girard). Small snakes with keeled scales in 17 rows; head distinct from the neck and very narrow and pointed: 1 species.

*P. striatulus* (L.) Length 280 mm.; tail 40 mm.; color grayish or reddish brown; belly red; ventrals 119 to 130; upper labials 5: southern and central States; northward into Virginia east of the mountains and into Minnesota west of them; southwestward into Texas; common in damp woods, under the bark of fallen trees and stones; viviparous.

**30. Amphiardis** Cope. Small snakes with indistinct head; scales keeled; anal plate divided; 2 internasals: 1 species.

*A. inornatus* (Garman). Length 250 mm.; tail 45 mm.; color uniform brownish olive; ventrals whitish: Texas and Oklahoma.

**31. Virginia** Baird & Girard. Small snakes with smooth scales in 15 to 17 rows; upper labials 6, ventrals 125: 2 species.

*V. valeriæ* B. & G. Length 180 mm.; tail 30 mm.; color grayish brown or chestnut, with minute black dots; belly yellowish white; scales in 15 rows: southern and central States; northward into New Jersey; westward to Tennessee; common; secretive.

*V. elegans* Kennicott. Similar to *V. valeriæ*, but differing in having scales in 17 rows: Indiana and Illinois to Texas.

**32. Thamnophis** Fitzinger. (*Eutænia* Baird & Girard). Garter snakes. Rather small, slender snakes, with a distinct head and keeled scales in 17 to 23 rows; upper labials usually 7 or 8; 3 longitudinal, more or less yellowish stripes; also several series of spots usually present; ventrals 130 to 180: about 24 species, all North American; 11 species in the United States, all viviparous; terrestrial and often aquatic, feeding on frogs, toads, worms and other cold blooded animals.

**Key to the United States Species of Thamnophis**

$a_1$ Scales in 19 rows.
  $b_1$ Upper labials 7.
    $c_1$ Lateral stripes on second and third rows of scales..... *T. sirtalis.*
    $c_2$ Lateral stripes on second, third and fourth rows of scales.... *T. butleri.*
    $c_3$ Lateral stripes on third and fourth rows of scales..... *T. sauritus.*
  $b_2$ Upper labials 8.
    $c_1$ In the central States..... *T. proximus.*

$c_2$ In Florida.....*T. sackeni.*
$a_2$ Scales in 21 rows.
$b_1$ Upper labials 7; on the Great Plains.....*T. radix.*
$b_2$ Upper labials 8.
$c_1$ Labials not dark bordered; western States.....*T. ordinoides.*
$c_2$ Labials dark bordered; southwestern States.
$d_1$ Spots 74 to 90.....*T. hammondi.*
$d_2$ Spots 50 to 60.....*T. marcianus.*

*T. sirtalis* (L.) Common garter snake (Fig. 123). Length 750 mm.; tail 130 mm.; color very variable, varying from greenish to blackish,

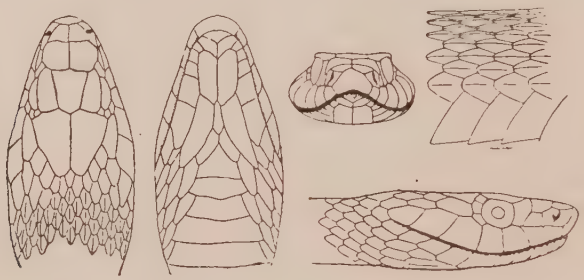


FIG. 123.—*Thamnophis sirtalis (from Cope).*

with 3 yellowish, longitudinal stripes and 2 or 3 series of black spots on each side, both stripes and spots being indistinct in some cases; belly greenish: entire country; our commonest snake.

### *Subspecies of T. sirtalis*

*T. s. sirtalis* (L.) Typical form: eastern and central States; westward to Minnesota and Missouri.

*T. s. concinnus* (Hallowell). A series of reddish, vertically elongated spots on each side; ground color black; throat and lips red; belly black: coast region of Oregon, Washington and British Columbia.

*T. s. parietalis* (Say). Ground color light brown; belly slate color; a series of vertical red bars on each side: Missouri to the coast of California and northward in Oregon and Washington east of the Sierra Nevadas and Cascades.

*T. butleri* (Cope). Length 440 mm.; tail 100 mm.; head very small: Michigan.

*T. sauritus* (L.) Ribbon snake. Length 660 mm.; tail 230 mm.; body very slender; stripes bright yellow: eastern States; westward to Michigan and Mississippi.

*T. proximus* (Say). Length 770 mm.; tail 220 mm.; body very slender; dorsal stripe orange in color, lateral stripes greenish: Nebraska, Iowa and southern Wisconsin to Louisiana and Texas; Mexico.

*T. sackeni* (Kennicott). Length 745 mm.; tail 160 mm.; color brown or olive; lateral stripes bright yellow; dorsal stripe indistinct or absent; no color blotches: Florida.

*T. radix* (B. & G.) Length 800 mm.; tail 170 mm.; stripes yellow; lateral stripes on the third and fourth rows of scales: the Great Plains from Kansas and Missouri northwestward; very common.

*T. ordinoides* (B. & G.) (*T. elegans* B. & G.). Length 700 mm.; tail 140 mm.; ground color dark brown or black; dorsal stripe bright yellow; lateral stripe faint, and on second and third rows of scales, or absent; back often with regular rows of large black blotches: coastal region of Pacific States; eastward to New Mexico and Wyoming.

*T. hammondi* (Kennicott). Length 500 mm.; tail 150 mm.; dorsal band absent and lateral bands indistinct; spots 74 to 90: southern California.

*T. marcianus* (B. & G.). Length 510 mm.; tail 160 mm.; color light yellow, with numerous square, black spots arranged like a checker board; belly white: Oklahoma and Texas to southeastern California.

**33. Liodytes** Cope. Stout snakes with a distinct head and smooth scales in 19 rows; caudal scales keeled; body tapering abruptly at both ends: 1 species.

*L. alleni* (Garman). Length 600 mm.; tail 135 mm.; color of back dark brown; sides with a broad olive band and a darker band beneath it; belly yellow, unspotted: Florida.

**34. Tantilla** Baird & Girard. Very small, somewhat poisonous snakes with smooth scales in 15 rows; ventrals about 150; upper labials 6 or 7; one or more pairs of grooved teeth at the rear of the upper jaw through which poison is injected: many species in the southern States and Mexico.

*T. coronata* B. & G. Length 230 mm.; tail 40 mm.; color reddish brown; lighter beneath; head black or dark brown; upper labials 7: South Carolina to Mississippi.

*T. gracilis* B. & G. Length 140 mm.; tail 30 mm.; color greenish brown; upper labials 6: Missouri to Texas.

*T. planiceps* (Blainville). Length 310 mm.; tail 80 mm.; color brown above; head black; upper labials 7: Kansas to Texas; westward to California.

**35. Trimorphodon** Cope. Medium sized, poisonous snakes with a flat broad and very distinct head; hinder maxillary teeth elongate and

grooved; scales smooth; anal plate divided; 2 nasals and 2 loreals on each side: about 10 species in Mexico; 1 in the United States.

*T. lyrophanes* (Cope). Length 700 mm.; tail 100 mm.; color gray, with about 20 pairs of brown blotches on the back in front of the anus; tail and sides also blotched; scales in 21 rows: southern Arizona and California.

**Family 4. Elapidæ.**—Elaphine snakes. Poisonous snakes with usually many teeth in both jaws, the front pair of teeth in the upper jaw forming a pair of short rigid fangs which are perforated each by a poison canal opening at the tip; subcaudals in two rows; head covered with plates and not scales: about 140 species in India, Africa, America and Australia, including many very poisonous ones; 1 genus in the United States. The largest of these snakes is the Indian cobra, which may attain a length of 10 or 12 feet and is, perhaps, the most deadly serpent known.

**Micrurus** Wagler (*Elaps* Schneider). Body slender and cylindrical; head small; no loreal; scales smooth and in 15 rows; anal plate divided: many species in tropical America; 2 in the United States.

*M. fulvius* (L.). Coral snake; harlequin snake. Length 930 mm.; tail 70 mm.; color red, black and yellow, arranged in bands encircling the body, there being about 14 broad red bands separated from as many broad black bands by narrow yellow rings; head and tail with only black and yellow; upper labials 7: south Atlantic and Gulf States from South Carolina to Texas; a burrowing snake which feeds on lizards and snakes, with a bite that may be very dangerous; the most deadly American snake; three-quarters of those bitten die.

*M. euryxanthus* (Kennicott). Similar to *M. fluvius*, but differing from it in that the first broad band back of the head is red instead of black: southern New Mexico and Arizona.

**Family 5. Crotalidæ.**—Rattlesnakes and copperheads; viperine snakes. Poisonous snakes with a thick body, a slender neck and a flat, triangular head; upper jaw without solid maxillary teeth, but with a pair of long poison fangs which are perforated each with a canal opening at the tip and lie against the roof of the mouth when not in use, but are erected or directed forward when the animal strikes; a deep pit present between the eye and the nostril; pupil vertical; subcaudals mostly undivided; anal plate undivided; the end of the tail in most species composed of horny rings (the rattle); scales keeled: 3 genera and about 18 species in the United States; about 6 genera in the Neotropic region and 4 genera in the old world; viviparous, but few young produced at a birth, at most a dozen or fifteen.

### Key to the United States Genera of Crotalidæ

$a_1$ No rattle present..... 1. *Agkistrodon.*
$a_2$ Rattle present.
  $b_1$ Top of head covered with plates (Fig. 126)..... 2. *Sistrurus.*
  $b_2$ Top of head covered with scales (Fig. 127)..... 3. *Crotalus.*

**1. Agkistrodon** Beauvois. Head covered with 9 symmetrical plates; no rattle present; scales in 23 or 25 rows; upper labials 8; ventrals 130 to 150; anterior subcaudals undivided, posterior ones divided: 10 species, 7 in Asia, 2 in the United States.

### Key to the Species of Agkistrodon

$a_1$ Scales in 23 rows; loreal plate present..... *A. mokasen.*
$a_2$ Scales in 25 rows; loreal plate absent..... *A. piscivorus.*

*A. mokasen* Beauvois (*A. contortrix* L.). Copperhead; moccasin (Fig. 124). Length 830 mm.; tail 120 mm.; color light brown, with about 15 transverse bands of darker brown which are narrow on top and very broad at the sides; head copper color; belly whitish, with a series

FIG. 124.—*Agkistrodon mokanse (from Cope).*

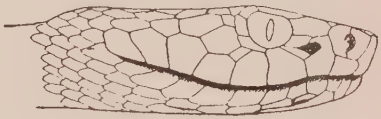


FIG. 125—*Agkistrodon piscivorus (from Cope).*

of large dark spots on each side: Massachusetts to northern Florida; westward to Illinois and Texas; sometimes abundant in swampy or rocky places, feeding on frogs, rodents, birds and snakes; bite very dangerous.

*A. piscivorus* (Lacépède). Water moccasin; cottonmouth (Fig. 125). Length 1,000 mm.; tail 190 mm.; color olive brown, crossed by 20 to 30 obscure darker bands; head purplish black; belly yellow, with black blotches: Atlantic and Gulf drainage from Virginia to eastern Texas; semiaquatic, often common along streams, feeding on frogs, fish, rodents and birds, for which the snakes will often lie in wait, perched in bushes overhanging the water; bite very dangerous.

**2. Sistrurus** Garman. Rather small snakes, with head covered with 9 symmetrical plates, and with a small rattle composed of not more than 8 rings; scales in 21 to 25 rows; upper labials 10 to 12; ventrals 125 to 145; subcaudals, except a few of the terminal ones, undivided: 3 species, 1 in Mexico.

*S. catenatus* (Rafinesque). Massasauga (Fig. 126). Length 800 mm.; tail 100 mm.; color light brown, with a middorsal series of 30 to 36 irregular dark brown blotches, each one edged with white, and 3 similar lateral series; belly mottled brown; melanistic coloring not uncommon; scales in 23 or 25 rows; upper labials 11 or 12: western New York to Nebraska; southward into Texas and Mexico; in wet fields and swamps, feeding on frogs and other small animals; bite very dangerous.

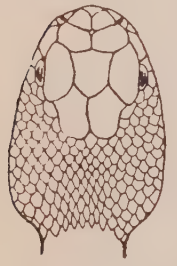


FIG. 126.—*Sistrurus catenatus (from Cope).*

*Subspecies of S. catenatus*

*S. c. catenatus* (Raf.). Scales in 25 rows; colors darker; blotcheslarger: eastern and central parts of range.

*S. c. edwardsi* (Baird & Girard). Scales in 23 rows; colors paler; blotches smaller: Oklahoma and western Texas.

*S. miliarius* (L.). Ground rattler. Length 430 mm.; tail 60 mm.; color gray, yellowish or brown, with a middorsal series of about 40 irregular spots or cross bars and 1 or 2 lateral series of smaller spots on each side; belly white, with numerous dark blotches; scales in 21 to 23 rows; upper labials 10 or 11: Atlantic and Gulf drainage from central North Carolina to Texas, and up the Mississippi Valley to Arkansas and Oklahoma; in wet places; the least dangerous of the rattlesnakes.

**3. Crotalus** L. Rattlesnakes. Head covered with scales, most species having also small plates between and in front of the eyes; rattle large and composed of at most 14 rings; scales in 23 to 31 rows; upper labials 12 to 16; ventrals about 175; subcaudals undivided: 15 species, in North and South America, 11 in the United States, all very dangerous snakes. The young rattler has no rattle, but a soft horny button at the end of its tail. During its first season it adds one horny ring to the button. In the succeeding seasons it usually adds 3 rings a year, the terminal rings usually becoming lost as the snake gets older.

**Key to the United States Species of Crotalus**

$a_1$ Tail all black (except the young of C. horridus).
  $b_1$ In the eastern and central States..... *C. horridus.*
  $b_2$ Along the Mexican border..... *C. molossus.*
$a_2$ Tail crossed with black or dark bands.
  $b_1$ In the southeastern and Gulf States..... *C. adamanteus.*
  $b_2$ In the States west of the Mississippi.
    $c_1$ With a middorsal series of diamond-shaped markings; in the southwest.

$d_1$ Size large; markings distinct.....*C. atrox.*
$d_2$ Size small; markings usually obscure.....*C. mitchelli.*
$c_2$ With a middorsal series of separated rounded blotches.
$d_1$ A pair of horns between the eyes.....*C. cerastes.*
$d_2$ No such horns present.
$e_1$ In the western prairie and Great Plains regions...*C. confluentes.*
$e_2$ In the southwestern and Pacific States.
$f_1$ Along the Mexican border.
$g_1$ Body with black rings at wide intervals.....*C. lepidus*
$g_2$ Body with 2 series of brown dorsal blotches..*C. pricei.*
$f_2$ In the extreme southwest.....*C. tigris.*
$f_3$ On the Pacific slope.....*C. oregonus.*

*C. horridus* L. Common rattlesnake (Fig. 127). Length 1,000 mm.; tail 130 mm.; greatest length 1,750 mm.; color yellowish brown, with about 22 wide, dark brown, more or less irregular cross bands, each of which is often broken into 3 separate irregular blotches; abdomen yellowish, with black spots; melanistic coloring not uncommon; tail of adult black; scales in 23 to 25 rows; upper labials 13 or 14: entire country east of the Rockies; northward to Maine; southward to northern Florida; in rocky regions, feeding on rodents and birds; bite very dangerous.

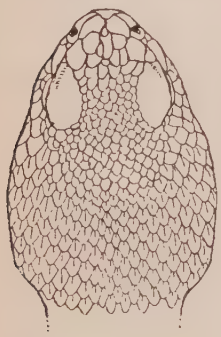


FIG. 127.—*Crotalus horridus (from Cope).*

*C. adamanteus* Beauvois. Diamond-back rattlesnake. Length 1,800 mm.; tail 220 mm.; diameter of body 100 mm.; greatest length 2,500 mm.; color olive or brown, with a dorsal series of about 20 more or less irregular diamond-shaped markings, each diamond enclosing the ground color; tail ringed with black; belly yellow; scales in 27 to 29 rows; upper labials 15: Atlantic and Gulf coastal regions, from North Carolina to Louisiana and Arkansas; in swamps and wet woods; the largest American poisonous snake.

*C. atrox* Baird & Girard. Length 1,300 mm.; tail 150 mm.; color gray with a dorsal series of brown, diamond-shaped spots, each bordered with white; scales in 27 rows; upper labials 15 or 16: Texas to Arizona, in arid regions; common.

*C. molossus* B. &. G Length 1,000 mm.; tail 80 mm.; color sulphur yellow, with a dorsal series of brown rhombs open at the side; tail black; scales in 29 rows: southern Texas to southern Arizona.

*C. cerastes* Hollowell. Sidewinder. Length 480 mm.; tail 50 mm.; a pair of conspicuous horn-like projections between the eyes; color light brown, with a middorsal series of about 40 brown square spots and a lateral series of small spots on each side; scales in 21 rows; upper labials 12: deserts of southern Utah and Nevada, Arizona and eastern California; the popular name applies to a curious sidewise method of locomotion.

*C. mitchelli* (Cope). Length 770 mm.; tail 87 mm.; color yellowish or gray, spotted dorsally in a general rhomboidal pattern, often obscure; scales in 23 or 25 rows; tail ringed with black: Arizona and southern California.

*C. confluentes* Say. Prairie rattler. Length 960 mm.; tail 100 mm.; body rather slender; color yellowish brown or green, with a middorsal series of about 40 irregularly rounded white-bordered brown blotches; a pale band passes from beneath the center of the eye to the angle of the mouth; scales in 25 to 27 rows; upper labials 14 or 15: the Great Plains from western Iowa to the Rockies, and from Canada to Texas; common, being frequently seen in prairie dog burrows, on the young of which they feed.

*C. lepidus* (Kennicott). Length 555 mm.; tail 50 mm.; color greenish with black rings at wide intervals; scales in 23 rows; upper labials 12: along the Mexican border of Texas, New Mexico and Arizona.

*C. pricei* Van Denburgh. Length 525 mm.; tail 60 mm.; color grayish brown, with 2 series of small brown blotches on the back; scales in 21 rows: southern Arizona.

*C. tigris* Kenn. Length 650 mm.; tail 50 mm.; color yellowish gray, with very indistinct blotches on the back and on the side, on the hinder two-thirds of the body forming cross bands; scales in 23 or 25 rows; upper labials 14: southern California, Nevada and Arizona.

*C. oregonus* Holbrook. Length 860 mm.; tail 90 mm.; color light brown, with a middorsal series of about 40 rounded or transverse brown blotches, which become rings towards the tail; scales in 20 to 25 rows; upper labials 15 or 16: entire Pacific Coast region, eastward into Idaho and Utah.

**Order 4. Testudinata.**—Turtles. Reptiles in which the body is wide and short, and is enclosed in a shell composed of a dorsal shield, called the *carapace*, and a ventral shield, the *plastron*. The shell, in most cases, is formed of large external, epidermal, horny plates (tortoise shell), which overlie internal bony plates. These latter consist, in the carapace, of the flattened ribs and the flattened trunk vertebræ which coalesce with overlying dermal bony plates, and are surrounded on

the circumference of the shell by a series of marginal dermal bony plates; in the plastron they consist of exclusively dermal plates, there being no sternum. The carapace and the plastron are more or less firmly united by a wide bridge on each side.

The head is a very solid and compact structure, and is often covered with scales. The jaws are toothless and are covered by a horny sheath which forms a cutting edge. The *Trionychidæ* are the only turtles which have fleshy lips. The eye has an upper and a lower lid and also a nictitating membrane. The tympanum is at the surface of the body, but in some species is hidden. The neck is long and flexible and has 8 vertebræ, and together with the head can usually be retracted within the shell. Two pairs of stout, pentadactyle limbs are always present, the toes of which are more or less webbed in the aquatic turtles. In the marine turtles the limbs are flippers, with a reduced number of toes. The tail is usually short and thick, and in many species ends with a claw. The skin covering the soft portion of the body is usually provided with scales.

**Habits and Distribution.**—Most species of turtles are more or less aquatic in their habits. The land turtles, however, live exclusively on the land, and will often drown if thrown into the water; and all of them, even the giant marine turtles whose limbs are flippers, come on to land to lay their eggs.

Turtles are noted for their tenacity of life. Many species can remain submerged in the water several hours without drowning. Some species have true water respiration. Species of the *Trionychidæ*, for instance, take water into the mouth and expel it regularly, when submerged, and a number of species have rectal respiration.

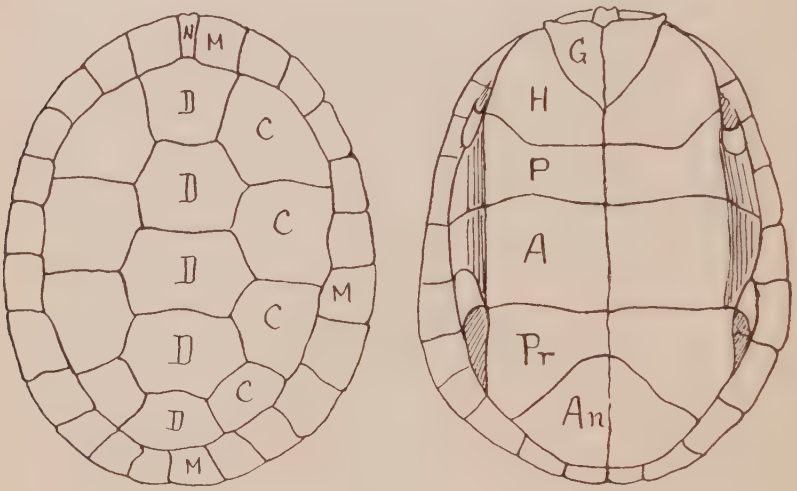
Turtles feed on vegital and animal food. The land turtles feed principally on the former, but also eat grubs, worms and other small animals they can catch. The aquatic turtles usually feed mainly on animal food, which they devour under the water. The snappers and soft-shells are fierce beasts of prey, which eat large numbers of fish, water birds and other animals which frequent the water.

Turtles usually breed in the late spring or early summer. All are oviviparous; the eggs are buried by the female in the sand or earth and are incubated by the heat of the sun.

About 260 species of turtles are known, of which about 50 species are found in the United States; these are grouped in 6 families.

**On the Identification of Turtles.**—The epidermal, horny plates forming the outer covering of the carapace fall into three groups, the *dorsal* or *vertebral*, the *lateral* or *costal* and the *marginal plates* (Fig.

128). The dorsal plates, in most turtles, form a median row of 5 plates; the lateral plates are paired and consist of a row of 4 or 5 plates on each side of the median row; the marginal plates form the margin of the carapace and number usually 12 pairs. The median anterior marginal is called the *nuchal plate*. The epidermal plates of the plastron are usually 11 or 12 in number (Fig. 128). In some turtles the epidermal plates are absent, the shell being covered with a leathery skin.




*a* *b*

FIG. 128.—Carapace (*a*) and plastron (*b*) of *Chrysemys marginata*, to show the plates: *A*, abdominal; *An*, anal; *C*, costal or lateral; *D*, dorsal or vertebral; *G*, gular; *H*, humeral; *M*, marginal; *N*, nuchal; *P*, pectoral; *Pr*, preanal (*from Hurter*).

The measurements used in the identification of turtles are those of the carapace, and in certain cases of the plastron also, and are always made in a straight line and not to follow the curve of the shell.

### Key to the Families of Testudinata

$a_1$ Limbs not in the form of flippers; land and pond turtles.
  $b_1$ Shell covered with horny plates.
    $c_1$ Tail short and without dorsal tubercles; plastron large and oval.
      $d_1$ Plastron with 9 to 11 horny plates; margin of carapace not flaring, but turned downwards (Fig. 130).....1. *Kinosternidæ.*
      $d_2$ Plastron with 12 horny plates; margin of carapace flaring outwards (Fig. 131).....3. *Testudinidæ.*
    $c_2$ Tail very long, with a dorsal row of tubercles (Fig. 129); plastron small, cross-shaped; snappers.....2. *Chelydridæ.*

$b_2$ Shell not covered with horny plates, but with a leathery skin.....4. *Trionychidæ.*
$a_2$ Limbs in the form of flippers; size very large; sea turtles.
$b_1$ Shell covered with horny plates.....5. *Cheloniidæ.*
$b_2$ Shell not covered with horny plates, but with a leathery skin.....6. *Dermochelidæ.*

**Family 1. Kinosternidæ.**—Mud and musk turtles. Rather small, aquatic turtles with an elongate body; carapace elliptical, with 23 marginal plates, usually smooth, without a flaring edge (Fig. 130); plastron

FIG. 129.—Tail of *Chelydra serpentina* (*from Surface*).

well developed, with movable anterior and posterior lobes, covered with 9 to 11 plates and joined with the carapace by narrow bridges; toes 5-5; claws 5-4; feet webbed; head pointed; jaws strong: 14 species, all American, 7 in the United States, in a single genus, inhabiting slow streams and muddy ponds, and eating animal food; eggs elliptical; all the species emit a musky odor.

**Kinosternon** Spix. Head with a large rhomboidal plate; plastron usually large, with a deep notch behind; tail with a terminal claw: 7 species.

**Key to the United States Species of Kinosternon**

$a_1$ Plastron very narrow and not covering the soft parts.
$b_1$ Head with yellow stripes.....*K. odoratum.*
$b_2$ Head spotted; shell with imbricated plates.....*K. carinatum.*
$a_2$ Plastron larger, covering the soft parts when closed.
$b_1$ Bridge very short, about a third the length of fore lobe of plastron.....*K. steindachneri.*
$b_2$ Bridge longer, about half the length of fore lobe of plastron.
$c_1$ Fore lobe shorter than hind; carapace with 3 yellow stripes.....*K. bauri.*
$c_2$ Fore lobe as long or longer than hind.
$d_1$ Head spotted with yellow.....*K. subrubrum.*
$d_2$ Sides of head bright yellow.....*K. flavescens.*
$d_3$ No yellow on head or body.....*K. sonoriense.*

*K. odoratum* (Latreille). Musk turtle. Carapace 90 mm. long and 60 mm. wide; color brownish, often striped or blotched with a darker color; plastron yellowish or brown; head large, with strong jaws; plastron 68 mm. long and 31 mm. wide; side of head with 2 narrow

yellow stripes, one passing above and the other beneath the eye: eastern and central States, from Canada to the Gulf; westward into Missouri and Texas; common; odor of musk strong.

*K. carinatum* (Gray). Similar to *K. odoratum* but with a prominent middorsal keel and with imbricated plates; head spotted with black, without stripes: Georgia to Louisiana.

*K. bauri* Garman. Carapace 900 mm. long and 65 mm. long; color brown or olive, with 3 yellow bands extending the length of the carapace: Florida and Georgia.

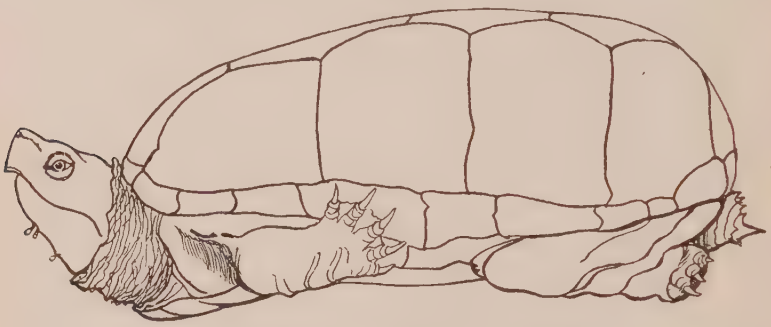


Fig. 130.—*Kinosternon subrubrum (from Surface).*

*K. steindachneri* Siebenrock. Similar to *K. subrubrum*, but differs in having a very short bridge: central Florida.

*K. subrubrum* (Lacépède) (*K. pensilvanicum* Gmelin). Common mud-turtle (Fig. 130). Carapace 85 mm. long and 60 mm. wide; plastron 78 mm. long and 37 mm. wide; color dark brown, with black sutures; plastron yellow or brown, with distinct lines of growth; head dark, with yellowish spots: eastern and central States, exclusive of peninsular Florida; westward to Texas, Missouri and eastern Illinois; common.

*Subspecies of K. subrubrum*

*K. s. hippocrepis* (Gray). Two orange bands on the side of the head: southern Alabama to Texas and northward in the Mississippi Valley to Missouri.

*K. flavescens* (Agassiz). Carapace 110 mm. long and 80 mm. wide; color yellowish brown and yellowish green; plastron yellow; sides of head and neck bright yellow: Texas to Arizona; northward to Kansas and Colorado.

*K. sonoriense* LeConte. Carapace 110 mm. long, 67 mm. wide; color brown, with faint darker radiating lines on each plate; vertebral plates imbricating: western Texas into southeastern California.

**Family 2. Chelydridæ.**—Snapping turtles. Body large, high in front; carapace rough and tuberculate, and with 24 marginal plates; plastron small, cruciform and composed of 10 plates, besides the 2 narrow bridges; head, neck and tail very large; jaws powerful and hooked; toes 5-5, with small webs; claws 5-4: 4 species, 3 in the United States; the largest turtles in the country (except the marine turtles), noted for their ferocity and voracity; aquatic, living on fish, waterbirds and other animals; flesh valued for food.

**Key to the Genera of Chelydridæ**

$a_1$ Head covered with a soft skin.....1. *Chelydra.*
$a_2$ Head covered with symmetrical plates.....2. *Macrochelys.*

**1. Chelydra** Schweigger. Carapace with 3 blunt keels, more or less pronounced, growing less so with age; tail very long, with 2 rows of scales beneath; eyes superior in position: 3 species, 1 in Central America.

*C. serpentina* (L.). Common snapper. Length 700 mm. or more; length of carapace 300 mm.; width 260 mm.; weight 30 lbs. or more; 2 chin barbels; a row of large compressed tubercles on the upper surface of the tail (Fig. 129); eggs spherical, 25 mm. in diameter, about 25 in number: North America, east of the Rockies, from Canada to the Gulf; common.

*C. osceola* Stejneger. Similar to *C. serpentina*, but with 4 chin barbels and 4 rows of nearly equal tubercles on the upper surface of the tail: Florida.

**2. Macrochelys** Gray. Head very large and covered above with plates; tail with small scales beneath; eyes lateral in position; carapace with 3 very prominent tuberculated ridges: 1 species.

*M. temmincki* (Holbrook). Alligator snapper. Length 1,000 mm.; length of carapace 620 mm.; width 530 mm.; weight 120 lbs.; eggs 35 mm. in diameter: Gulf States; northward in the Mississippi Valley into northern Missouri.

**Family 3. Testudinidæ.**—Pond and land turtles. Carapace ovate and with flaring edges (Fig. 131) and either depressed or more or less strongly convex, and covered with 5 dorsals, 4 pairs of costals and 25 marginals; plastron covered with 12 plates, and of large size and firmly joined with the carapace by wide bridges, and in some species with a movable anterior lobe enabling the animal to close its shell; toes 5-4; eggs elliptical: about 80 species, 30 species in the United States; many species are used for food.

### Key to the Genera of Testudinidæ

$a_1$ Digits spreading, not closely bound together.
  $b_1$ Plastron without hinge, immovably joined to carapace.
    $c_1$ Carapace usually keeled.
      $d_1$ Size small; mostly under 150 mm. long; keel often indistinct or wanting.....1. *Clemmys.*
      $d_2$ Size moderate, carapace over 150 mm. long.
        $e_1$ Salt marsh turtles; along the Atlantic and Gulf coasts; plates with growth lines.....4. *Malaclemys.*
        $e_2$ In the central States; plates nearly smooth.....5. *Graptemys.*
    $c_2$ Carapace not keeled.
      $d_1$ Carapace smooth, with rounded margin; size small.
        $e_1$ Carapace with red markings.....6. *Chrysemys.*
        $e_2$ Carapace without red markings.....8. *Deirochelys.*
      $d_2$ Carapace with serrated hinder margin.....7. *Pseudemys.*
  $b_2$ Plastron with hinge across the middle, enabling the animal to close its shell.
    $c_1$ Body depressed; plastron notched behind; upper jaw notched in front.....2. *Emys.*
    $c_2$ Body arched; plastron rounded or truncate behind; upper jaw hooked in front.....3. *Terrapene.*
$a_2$ Digits club-shaped, being closely bound together, only the last joint being free; southern States.....9. *Gopherus.*

**1. Clemmys** Ritgen. Wood-tortoises. Small turtles with usually a depressed carapace with a more or less prominent keel; plastron joined with the carapace by a wide rigid bridge; feet more or less webbed: 4 United States species.

### Key to the Species of Clemmys

$a_1$ In the eastern and central States.
  $b_1$ Carapace with small yellow spots on a black background....*C. guttata.*
  $b_2$ Carapace with deep concentric grooves in each plate and serrated behind.....*C. insculpta.*
  $b_3$ Head with a large yellow or orange spot on each side.....*C. muhlenbergi.*
$a_2$ On the Pacific slope.....*C. marmorata.*

*C. guttata* (Schneider). Spotted turtle (Fig. 131). Body black above, with numerous small round orange or yellow spots; plastron black, blotched with yellow or orange; carapace smooth, without keel, 100 mm. long and 75 mm. wide: eastern States; southward to northern Florida; westward to southern Michigan; very common.

*C. insculpta* (LeConte). Wood-turtle. Shell dark gray or brown in color and much roughened by deep concentric grooves and ridges on each plate; plastron yellow, with a large black blotch on each plate; carapace keeled; length 150 mm.; width 120 mm.; soft parts,

except the top of the head and the limbs, red: northeastern States; southward to the District of Columbia; westward to Wisconsin; terrestrial, in fields and woods; valued for food.

FIG. 131.—*Clemmys guttata* (*from Fowler*).

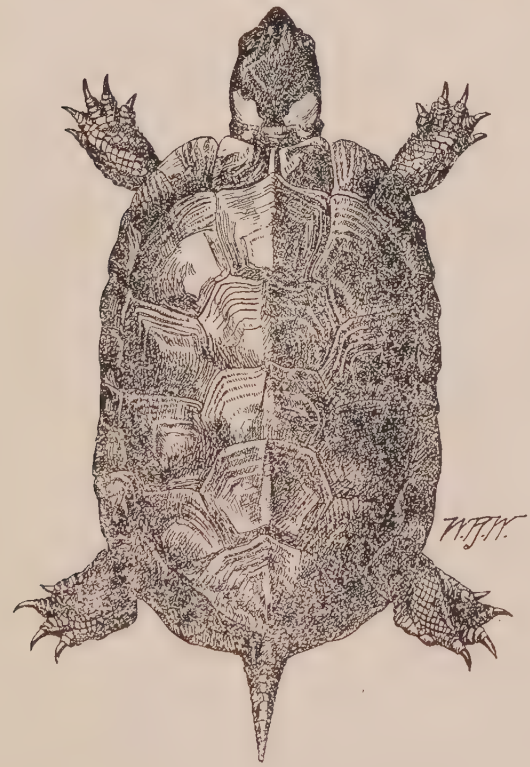


FIG. 132.—*Clemmys muhlenbergi* (*from Surface*).

*C. marmorata* (Baird & Girard). Carapace smooth, dark brown or black in color, with numerous yellow dots or dashes; plastron black

and yellow; length of carapace 150 mm.: entire Pacific slope, in ponds and rivers; common.

*C. muhlenbergi* (Schœpff)(Fig. 132). Carapace with fine concentric lines on the plates in young adults, and dark brown or black in color, with yellowish or reddish markings; head black, with a large orange or yellow spot on each side; length of carapace 100 mm.; width 65 mm.: New Jersey and southeastern Pennsylvania to Rhode Island and central New York; mountains of western North Carolina; in marshes and ponds and small streams; often common.

**2. Emys** Duméril. Shell moderately high, with narrow bridges; plastron notched behind, movable and joined with the carapace by a ligament on each side; a transverse hinge in front of the bridges divides the plastron into 2 lobes, both of which are movable, although the shell cannot be completely closed; digits webbed: 1 species.

FIG. 133.—*Emys blandingi* (*from Fowler*).

*E. blandingi* (Holbrook) (Fig. 133). Carapace black, with numerous small yellow spots; plastron yellow in the center, with large irregular black blotches along the two sides; length of carapace 200 mm.; width 120 mm.: north-central States and New England; westward to Minnesota; not common.

**3. Terrapene** Merrem (*Cistudo* Fleming). Box-turtles. Shell high and very convex; plastron large, united with the carapace by a ligament on each side, rounded at both ends, and with a transverse hinge which divides it into two movable lobes so that the shell can be completely closed; upper jaw with a beak; digits with a small web or with none: 3 species.

**Key to the Species of Terrapene**

$a_1$ Carapace keeled.
  $b_1$ Carapace irregularly marked with yellow..... .....*T. carolina.*
  $b_2$ Carapace with yellow radiating lines.....*T. major.*
$a_2$ Carapace not keeled.....*T. ornata.*

*T. carolina* (L.). Common box-turtle: Shell more or less globular, with a blunt keel; color yellow and blackish, but very variable; male usually with red eyes, female usually with yellow; length of carapace 130 mm.; width 115 mm.; height 70 mm.: eastern and southern States; terrestrial; common.

*Subspecies of T. carolina*

*T. c. carolina* (L.). Eastern States; southward to Georgia; westward to Tennessee and western Illinois; northward to central Michigan and Maine.

*T. c. triunguis* (Agassiz). Hind foot with but 3 claws; yellow markings usually obscure: Gulf slope; westward into Texas; northward into Missouri.

FIG. 134.—*Malaclemys centrata (from Fowler).*

*T. major* (Agassiz). Similar to *T. carolina;* size large; carapace 180 mm. long, and with yellow radiating lines: Gulf States from Florida to Texas.

*T. ornata* (Agassiz). Similar to *T. carolina,* but without a keel; fore legs usually red: Indiana to the Rocky Mountains; southward to the gulf of Mexico and Arizona; often common.

**4. Malaclemys** Gray. Salt marsh turtles. Carapace depressed and with a keel; plastron without a hinge and immovably joined with the carapace; feet large and webbed; head covered with a soft skin: 2 species.

**Key to the Species of Malaclemys**

$a_1$ On the Atlantic slope.....*M. centrata.*
$a_2$ On the Gulf slope.....*M. pileata.*

*M. centrata* (Latreille). Diamond-back terrapin (Fig. 134). Shell rough, each plate having concentric lines of growth; carapace dark olive or grayish in color and 180 mm. long and 130 mm. wide; weight 2 lbs.; legs and head spotted; plastron yellow; young individuals whitish, with black concentric lines; head without stripes: salt marshes from Massachusetts to Florida, where it feeds on crustaceans and mollusks; highly prized for food.

*Subspecies of M. centrata*

*M. c. centrata* (Lat.). Cape Hatteras to Florida.

*M. c. concentrica* (Shaw). Size smaller; concentric lines on each plate very distinct: Massachusetts to Cape Hatteras.

*M. pileata* (Wied). Similar to *M. centrata;* carapace with a more or less tuberculate keel and black or brown in color, with distinct concentric lines on each plate: Gulf coast.

*Subspecies of M. pileata*

*M. p. pileata* (Wied). Color black or very dark brown; top of head dark: Gulf coast, from Florida to the Mississippi River.

*M. p. littoralis* (W. P. Hay). Color light brown; top of head white: coast of Texas.

*M. p. macrospilota* (W. P. Hay). Each plate of carapace with a large central yellow or orange blotch: west coast of Florida.

**5. Graptemys** Agassiz. Map turtles. Carapace depressed and with a keel; plastron without a hinge and immovably joined with the carapace; head covered with a soft skin; lower jaw with a dilatation at the tip: 2 species.

**Key to the Species of Graptemys**

$a_1$ A triangular yellowish spot back of eye; keel not serrate...*G. geographica.*
$a_2$ A transverse cresent back of eye; keel serrate.....*G. pseudogeographica.*

*G. geographica* (LeSueur) (Fig. 135). Body dark brown and marked with a network of greenish and yellowish lines; plastron yellow; length of carapace 240 mm.; width 180 mm.; carapace circular, notched at the sutures of the marginal plates: central States; eastward into New York and Pennsylvania; westward into Missouri and Arkansas; northward to Michigan and Lake Champlain; common.

*G. pseudogeographica* (Gray). Similar to *G. geographica* but with a more distinct keel; median row of plates imbricated and each with a high tubercle; no yellowish net-work on carapace; head, neck and legs with bright yellow stripes: Mississippi Valley and Gulf slope.

FIG. 135.—*Graptemys geographica* (*from Fowler*).

*Subspecies of G. pseudogeographica*

*G. p. pseudogeographica* (Gray). Each dorsal plate with a large dark blotch: eastward to Alabama and Ohio; northward to Wisconsin; westward to Kansas and Oklahoma.

*G. p. kohni* (Baur). A large yellow spot behind the eye: Pensacola to eastern Texas.

*G. p. oculifera* (Baur). A yellow spot behind the eye, and 2 yellow stripes on the neck: southern Louisiana.

**6. Chrysemys** Gray. Painted turtles. Carapace smooth, depressed, without keel, and with wide bridges which join it immovably with the plastron; feet webbed, with long claws; no concentric lines on the plates of the carapace: 2 species.

**Key to the Species of Chrysemys**

$a_1$ In the central States.....*C. marginata.*
$a_2$ On the Atlantic slope.....*C. picta.*

*C. marginata* Agassiz (Fig. 128). Carapace smooth, dark olive or brown in color, the plates margined with yellow; throat striped with yellow; marginal plates above and beneath blotched with crimson, which may disappear on the dorsal marginal plates in old specimens; plastron yellow, with a broad blackish patch in the center; vertebral row of plates of the carapace alternating with those of the costal rows; length of the carapace 125 mm.; width 90 mm.: central and western States; very common.

*Subspecies of C. marginata*

*C. m. marginata* Agassiz. Northern New York to Wisconsin; southward to Missouri.

*C. m. belli* (Gray). Yellow margins of dorsal plates absent; plastron with a pair of wide black bands joined at the ends: Great Plains; westward to Vancouver Island; northeastward to northern Michigan.

*C. m. dorsalis* Agassiz. Carapace with a yellow dorsal stripe: lower Mississippi Valley; northward to Missouri.

FIG. 136.—*Chrysemys picta (from Fowler).*

*C. picta* (Schneider) (Fig. 136). Similar to *C. marginata;* plastron yellow; vertebrals nearly in same transverse line as costals: eastern States from New Brunswick to Georgia; very common.

**7. Pseudemys** Gray. Sliders; cooters. Carapace moderately depressed, with a serrate hinder margin; plastron notched behind; upper jaw notched in front; head covered with a hard skin: 10 species.

**Key to the Species of Pseudemys**

$a_1$ Carapace smooth—not wrinkled with parallel grooves.....*P. troosti.*
$a_2$ Carapace wrinkled, especially along the sides.
  $b_1$ Edges of jaws smooth—not serrate.
    $c_1$ Elongate red patch back of eye.....*P. elegans.*
    $c_2$ Broad yellow patch back of eye.....*P. scripta.*
  $b_2$ Lower jaw serrate.
      $c_1$ Upper jaw smooth.....*P. concinna.*
      $c_2$ Upper jaw serrate, at least with central notch and lateral cusp.
        $d_1$ Plastron red; Atlantic coastal plain.....*P. rubriventris.*
        $d_2$ Plastron yellow; Gulf States and lower Mississippi Valley.

$e_1$ In central Florida.....*P. floridana.*
$e_2$ In Gulf coast region.....*P. alabamensis.*
$e_3$ From Missouri to Mexico.....*P. texana.*

*P. troosti* (Holbrook). Carapace greenish black, with darker blotches; under surface of marginals and plastron yellow, with black blotches; no head or neck markings; edges of both jaws smooth; length of carapace 200 mm.; width 150 mm.: Mississippi Valley; northward to northern Missouri and southern Indiana; common; used for food.

*P. elegans* (Wied). Carapace dark olive or brown, with dull yellow lines and spots; plastron yellow, with a black blotch on each scale; head and neck with numerous yellow lines and a broad red spot back of the eye; length of the carapace 250 mm.; width 180 mm.: Texas and Mississippi Valley; northward to Iowa and Ohio; common; used for food.

FIG. 137.—*Pseudemys rubriventris* (*from Fowler*).

*P. scripta* (Schœpff). Carapace dark brown in color, with dull yellow transverse stripes; plastron yellow; length of carapace 250 mm.; width 170 mm.; head with a broad yellow spot just back of the eye: Georgia to North Carolina.

*P. concinna* (LeConte). Shell broad and flat; carapace wrinkled on the sides, olive or brownish in color with yellow or brownish markings; plastron yellow; head black, striped with red or yellow; length of carapace 300 mm.; width 210 mm.: southern Maryland to Georgia, Louisiana and Illinois; in rivers.

*P. rubriventris* (LeConte). Red-bellied terrapin (Fig. 137). Carapace brownish, streaked or blotched with red; plastron red, often tending towards orange or yellow; length of carapace 300 mm.; width 180 mm.; height 110 mm.; extreme length of carapace 450 mm.: eastern

States from Cape Cod to Florida, usually in coastal plain rivers; the largest turtle in this territory except the snapper; used for food.

*P. floridana* (LeConte). Carapace circular and very high; head black, very small; carapace dark brown, with wavy yellow cross bars, 325 mm. long and 225 mm. wide; plastron yellow; lower jaw nearly smooth: Florida and southern Georgia.

*P. alabamensis* Baur. Carapace high and 300 mm. long; plastron yellow; color similar to *P. rubriventris:* Gulf coast from Florida to Louisiana.

*P. texana* Baur. Carapace brown, with yellow concentric lines; plastron yellow; head streaked with yellow; length of carapace 230 mm.; width 170 mm.: southwestern Missouri to Texas and Mexico.

**8. Deirochelys** Agassiz. Similar to *Chrysemys;* upper jaw notched in front; lower jaw arched upwards and terminating in a sharp point; neck long: 1 species.

*D. reticularia* (Latreille). Chicken turtle. Carapace narrow, rather high, and olive or brown in color with a net-work of fine yellow lines, each upper marginal with a yellow bar and each under marginal with a black blotch on a yellow field; plastron yellow; length of carapace 125 mm.; width 80 mm.; neck very long: Atlantic and Gulf coastal plain from central North Carolina to and including the Mississippi alluvial plain; southward to central Florida.

**9. Gopherus** Rafinesque. Land tortoises. Shell high and dome-like; plastron large and often with a hinged front lobe; feet not webbed: 3 species in the United States, all herbivorous and strictly terrestrial; they are allied to the giant land tortoises of the Galapagos Islands, the largest of which has a carapace a meter and a third in length and weighs over 225 kilos.

**Key to the United States Species of Gopherus**

$a_1$ In the southern and south-central States.....*G. polyphemus.*
$a_2$ In Texas.....*G. berlandieri.*
$a_3$ In the extreme southwest.....*G. agassizii.*

*G. polyphemus* (Daudin). Gopher turtle. Carapace with concentric lines on each scale, brownish in color; plastron dull yellow, notched behind, extending beyond the carapace in front; length of carapace 280 mm.; width 200 mm.; inner surface of fore arm with enlarged scales: south Atlantic and Gulf States; northward to South Carolina and Arkansas; gregarious, living in dry, sandy regions and burrowing in the ground. The burrow runs obliquely in the ground to a depth of 4 or more feet, and is enlarged at the end, where a single pair lives.

*G. agassizii* (Cooper). Similar to *G. polyphemus;* no enlarged scales on the inner surface of the fore arm: southwestern Arizona and southeastern California.

*G. berlandieri* (Agassiz). Shell globular, being very broad and high; carapace brown and 150 mm. long, 136 mm. wide and 80 mm. high; plastron yellow: deserts of southern Arizona, Nevada and California.

**Family 4. Trionychidæ.**—The soft-shell turtles. Large turtles with a flat, circular shell which is covered with a leathery skin and not with horny plates or scales; ossification of the carapace not complete; neck very long; head pointed, ending in a flexible proboscis-like snout; jaws powerful, with fleshy lips; feet webbed; toes 5-5; claws 3-3: about 30 species, in both hemispheres, 4 in the United States; savage, active turtles, aquatic and carnivorous, valued for food; eggs spherical. It has been demonstrated that these turtles can remain under water several hours at a time, and that they have true water respiration when submerged, taking in water into the mouth and expelling it regularly about 16 times a minute.

**Amyda** Oken. With the characters of the family: 4 United States species.

**Key to the Species of Amyda**

$a_1$ Fore part of carapace smooth.....*A. mutica.*
$a_2$ Fore part of carapace with conical tubercles.
  $b_1$ Light stripes on head unite between the eyes.....*A. emoryi.*
  $b_2$ Light stripes on head unite at end of the snout.....*A. spinifer.*
  $b_3$ Light stripes on head unite in front of the orbits.....*A. ferox.*

*A. mutica* (LeSueur). Body brown in color, irregularly blotched, being spotted in the young; whitish below; length of carapace 170 mm.; width 160 mm.: central and northern tributaries of the Mississippi; tributaries of the Great Lakes and St. Lawrence; not so common as *A. spinifer.*

*A. emoryi* (Agassiz). Similar to *A. spinifer:* Texas and into southern Oklahoma and Arkansas.

*A. spinifer* (LeSueur). Soft-shell turtle (Fig. 138). Body olive brown in color, with numerous round dark spots, each margined with black in young animals; head and neck olive, with stripes; tubercles on forward edge of carapace larger in the female than in the male; plastron white; length of carapace 350 mm.; width 300 mm.: north-central States; eastward to Vermont and western Pennsylvania; westward to Colorado; southward to Kentucky; common.

*A. ferox* (Schneider). Large turtles similar to *A. spinifer*, but plain brown in color in the adult; young spotted or blotched; length of carapace 450 mm.; width 370 mm.; weight 13 kilos: Gulf States from South Carolina to Louisiana; common.

**Family 5. Cheloniidæ.**—Marine turtles of large size, in which the shell is covered with large horny plates; carapace depressed, highest in front; head large, covered with plates and incompletely retractile; limbs in form of flippers, with 1 or 2 claws on each; eggs spherical: 7 species, which live in the open ocean in the warmer parts of the earth, coming to the shore on tropical and subtropical beaches to bury their eggs.

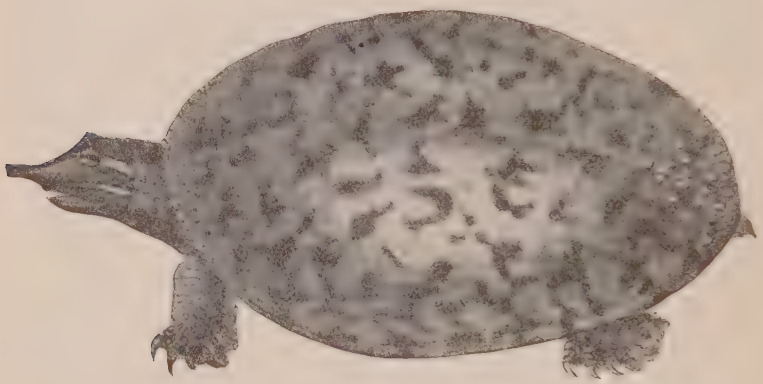


FIG. 138.—*Amyda spinifer* (*from Fowler*).

**Key to the Genera of Cheloniidæ.**

$a_1$ Four costal plates on each side.
  $b_1$ Plates of carapace imbricated.....1. *Eretmochelys.*
  $b_2$ Plates of carapace not imbricated.....2. *Chelonia.*
$a_2$ Five costal plates on each side.....3. *Caretta.*

**1. Eretmochelys** Fitzinger. Head broad, with a large median plate surrounded by 7 smaller ones; costal plates 4 on a side; 7 to 10 plates on each cheek: 2 species.

*E. imbricata* (L.). Tortoise shell turtle; hawk-bill. Body brown or blackish above and yellow beneath; upper jaw with a hooked tip; each foot with 2 claws; length of carapace 750 mm.: tropical seas; the Florida and Gulf coasts; occasionally as far north as Massachusetts; valued for the tortoise shell of commerce, this turtle being the only one which furnishes it.

**2. Chelonia** Latreille. Top of head with a large median plate surrounded by 7 smaller ones; costal plates 4 on a side; 15 to 20 plates on each cheek; head narrow: 2 species.

*C. mydas* (L.). Green turtle. Body olive or brown above, marked with yellow, and yellow beneath; length of carapace 1,200 mm. or less; weight up to 500 lbs.; 1 claw on each foot: tropical seas; Atlantic Ocean as far north as Massachusetts; valued for food, the fat being green; common.

**3. Caretta** Rafinesque. Top of head with a large median plate surrounded by 13 to 20 smaller ones; costal plates 5 on a side; 15 to 20 plates on each cheek; head broad: 3 species.

*C. caretta* (L.). Loggerhead turtle. Body brown above, yellowish below; feet with 2 claws each; length of carapace 1 m. and more; weight 350 lbs. and more: tropical seas; northward as far as Massachusetts; common on the West India and Florida coasts; flesh and eggs used for food.

*C. kempi* (Garman). Bastard turtle. Similar to *C. caretta*, but with ridges on the crushing surfaces of the jaws under the horny sheaths: south Atlantic; as far north as New Jersey.

**Family 6. Dermochelidæ.**—Sea turtles with the body covered with a smooth leathery skin; carapace with 7 longitudinal ridges; toes without claws: 1 genus.

**Dermochelys** Blainville. With the characters of the family: 1 species.

*D. coriacea* (L.). Leather-turtle; trunk-back. Color dark brown; length of carapace 1,500 mm.; width 900 mm.; weight 700 lbs. and more: tropical seas; northward as far as Maine.

## CLASS 5. MAMMALS (Mammalia)

Warm-blooded, air-breathing vertebrates which have a hairy integument. With the exception of the Australian monotremes all mammals are viviparous and all possess mammary glands on the ventral body surface with which they suckle their young, in the marsupials these glands being located in an integumental pouch. The teeth are adapted to the grasping and chewing of food, there being four different forms, the *incisors* or front teeth, the *canines*, and the *premolars* and *molars* which are the back teeth or grinders. The heart is composed of four chambers, two ventricles and two auricles; there is a single (left) aortic arch and the blood contains non-nucleated red blood-corpuscles. The head articulates with the neck by two occipital condyles and there are, with rare exceptions (the Florida manatee alone of American mammals), seven cervical vertebræ. The lower jaw consists of a single bone on each side and articulates directly with the cranium and not by means of the quadrate bones. An external ear in form of a large integumental fold is, with the exception of certain aquatic mammals, present. The cochlea is spirally coiled, and the tympanum is joined with the inner ear by means of the three ear-ossicles. The abdominal cavity is separated from the thoracic by means of a muscular diaphragm.

**On the Identification of Mammals.**—The measurements of a species of mammals are given in millimeters and include (1) the length of the body from the tip of the snout to the hinder end of the vertebræ of the tail, (2) the length of the tail measured from its base to the hinder end of its vertebræ and (3) the length of the hind foot measured from the bend of the ankle to the tip of the longest toe. An average large male specimen is probably generally used in making the measurements, but it must be remembered that individual differences always exist between individuals of a species, due to differences in age, sex, locality and environmental conditions, and that a considerable margin must be allowed for these differences. The color of a species is also to a certain extent variable, and is much more so in some species of mammals than in others.

The general form of the body and that of its various parts are usually noted, and also any peculiarities of form or color which would tend to mark a species or larger group. The dentition, or number of teeth,

is a constant and very important character, and is given in this book in the following manner, the figures referring to the number of incisor, canine, premolar and molar teeth on each side of the jaws: "dentition 3/3, 1/1, 4/4, 2/3," the meaning of which is that on each side of the

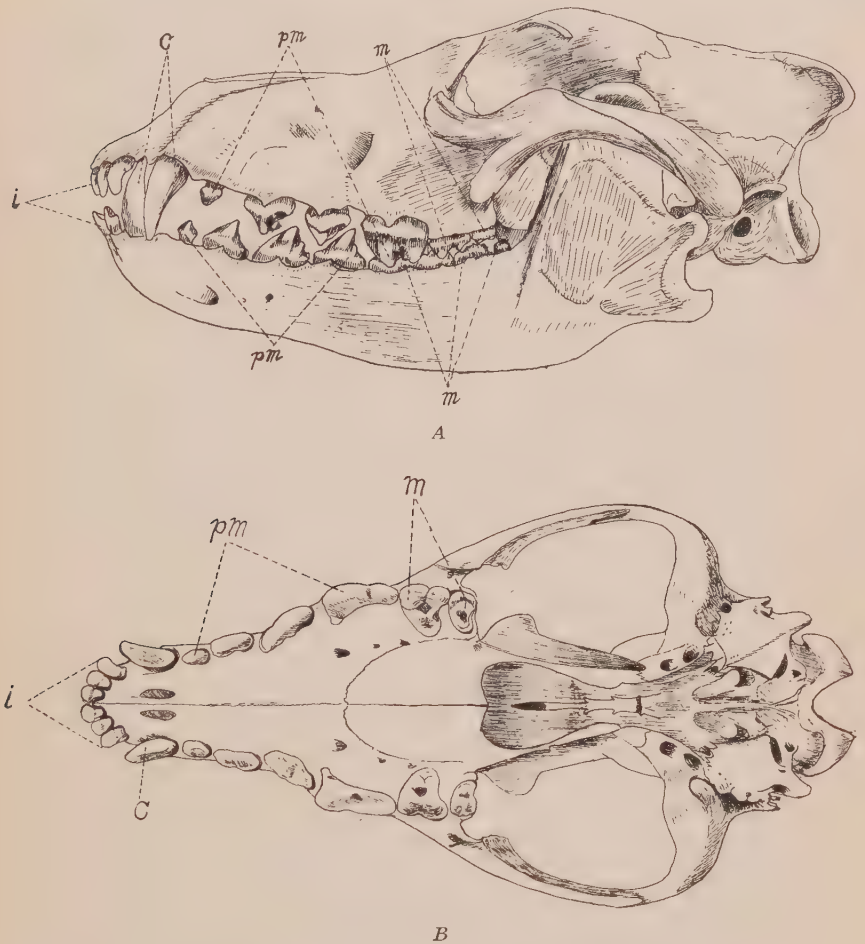



FIG. 139.—Skull of dog, showing dentition, the formula of which is 3/3, 1/1, 4/4, 2/3: *A* side view; *B*, upper jaw; *c*, canines; *i*, incisors; *m*, molars; *pm*, premolars.

mouth there are 3 upper and 3 lower incisors, 1 upper and 1 lower canine, 4 upper and 4 lower premolars and 2 upper and 3 lower molars. This is the dentition of the dog (Fig. 139), which has thus 10 teeth in the upper jaw on each side and 11 teeth in the lower jaw on each side or 20 teeth in the upper jaw on both sides and 22 teeth in the lower jaw on both sides, and 42 teeth altogether. The dentition of the pocket gopher is 1/1, 0/0, 1/1, 3/3, the meaning of which is that this animal has

1 upper and 1 lower incisor on each side or 2 upper and 2 lower incisors altogether, no canines in either jaw, 1 upper and 1 lower premolar on each side and 3 upper and 3 lower molars on each side, or 10 teeth in the upper jaw on both sides and 10 teeth in the lower jaw on both sides, or 20 teeth altogether.

The friction pads of the feet are called the *plantar tubercles* (Fig. 163) and are employed in certain species of rodents for purposes of identifications.

In a country as large as the United States, in which the conditions of climate, rain-fall, moisture and altitude are so very varied, and where forests, plains and deserts, large and small rivers, lakes and marshes form an endless succession of localities which harbor mammalian life, any species which inhabits any considerable area is sure to be divided into a number of geographical races or subspecies. Often the best means of identifying a mammal is to tell where and under what conditions it lives, and the descriptions in this book usually give such details.

**History.**—The *Mammalia* as a definite scientific group of animals has existed in the literature since the time of Aristotle. Linnæus made it one of the six classes into which he divided the Animal Kingdom, and Lamarck one of the classes of *Vertebrata*.

About 3,500 species of mammals are known, grouped in about 15 orders, of which 9 are represented in the United States.

**Key to the Orders of Mammals in the United States**

$a_1$ A marsupial pouch present; opossums.....1. *Marsupialia*
$a_2$ No marsupial pouch present.
  $b_1$ Hind limbs wanting; manatees.....3. *Sirenia.*
  $b_2$ Hind limbs present.
    $c_1$ Body covered with a bony shell; armadillos.....2. *Edentata.*
    $c_2$ Body not so covered.
      $d_1$ Flying mammals; bats.....5. *Chiroptera.*
      $d_2$ Non-flying mammals.
        $e_1$ Feet with claws and not with hoofs.
          $f_1$ Canine teeth present.
            $g_1$ Limbs used mainly for walking and running.
              $h_1$ Canines small; moles and shrews.....4. *Insectivora.*
              $h_2$ Canines prominent.....6. *Carnivora.*
            $g_2$ Limbs used mainly for swimming; seals....7. *Pinnipedia.*
          $f_2$ Canines absent.....8. *Rodentia.*
        $e_2$ Feet with hoofs.....9. *Ungulata.*

**Order 1. Marsupialia.**—Aplacental mammals in which the young are born in a very immature condition and are maintained by the

mother in an abdominal pouch called the *marsupium*, in which the nipples of the milk-glands are situated. The marsupium is supported on each side by the marsupial bone which projects forward from the pelvis and is present in both sexes. The uterus and vagina are double and paired.

The marsupials vary much in their general form and in the form of their teeth, and the different groups are fitted to maintain themselves in very diverse environments. About 150 species are known, grouped in 2 suborders, all of which, with the exception of about two dozen American species, inhabit Australia and the neighboring islands.

**Key to the Suborders of Marsupialia**

$a_1$ Prominent eye-teeth present; carnivorous species.....1. *Polyprotodontia.*
$a_2$ Eye-teeth small or wanting; herbivorous species (not present in America).....2. *Diprotodontia.*

**Suborder Polyprotodontia.**—Carnivorous marsupials with 4 or 5 upper and 3 or 4 lower incisors, prominent canines and cuspidate molars: 4 families, in the American and Australian regions, 1 in America.

**Family Didelphyidæ.**—Opossums. Body rather slender, tail long and prehensile and scaly; legs of about equal length; feet pentadactylous; first digit opposable; dentition 5/4, 1/1, 3/3, 4/4: 10 genera, all American, mostly tropical; arboreal or aquatic; 5 genera and 22 species in North and Central America; 1 genus in the United States.

**Didelphis** L. Marsupial pouch well developed; fur a mixture of soft hairs and bristles: about 4 species, 1 in the United States.

*D. virginiana* Kerr. Common opossum. Length 700 mm.; tail 300 mm.; color dirty white on the sides, gray on the back: eastern and central States, from Long Island and the Great Lakes to the Gulf; westward to Louisiana, Oklahoma and Nebraska; arboreal animals which feed on birds, insects and reptiles, as well as on nuts, corn and fruit. The young are often carried on the mother's back when they are big enough to leave her pouch, clinging to her fur or holding on by entwining their tails around hers as she holds it over her back. The nest is usually in a hollow tree; the young number from 5 to 14 and two or three litters are raised in a season. A new-born opossum is about 12 mm. long.

*Subspecies of D. virginiana*

*D. v. texensis* Allen. Color black or gray: southwestern Texas; northward to San Antonio.

*D. v. pigra* Bangs. Smaller and with a much longer and slenderer tail and smaller feet: Florida and the Gulf coast; westward to western Louisiana.

**Order 2. Edentata.**—Mammals either without teeth or with primitive, conical teeth which lack enamel and never form a complete series, canines and incisors being generally absent: about 100 species, which include armadillos, anteaters and sloths, most of which live in South and Central America; two genera in Africa and Asia; 1 species in the United States.

**Family Dasypodidæ.**—Head narrow; snout long; body almost hairless and covered with a bony carapace in which are 6 to 12 movable rings in the middle region; tail long; toes 4-5, all with strong, curved claws: 2 genera; nocturnal, burrowing animals, feeding mainly on insects which they lick up with the sticky surface of their extensile tongues.

**Dasypus** L. With the characters of the family; toes on the fore feet nearly symmetrical: 1 species.

*D. novemcinctus* L. The nine-banded armadillo. Carapace with 8 movable rings in the middle and 9 on the sides; tail very long and covered with 12 or more rings; top of head and legs covered with scales; color of head pale brown, of back black, of sides yellowish white; length 240 mm.; tail 90 mm.; hind foot 30 mm.; dentition 0/0, 0/0, 0/0, 8/8: southern Texas and New Mexico, and southward to Argentina; 4 or 8 young at a birth in respectively either one or two monozygotic groups of quadruplets. The armor is a protection against cactus and other spiny plants and not against animal foes, as the animal does not coil itself into a ball when attacked.

**Order 3. Sirenia.**—Aquatic, herbivorous mammals of large size without hind limbs or external ears; cervical vertebræ 6; fore limbs oval flippers; tail rounded and flattened; 1 pair of thoracic mammæ; body naked: 2 families, 1 American.

**Family Trichechidæ.**—With the characters of the order; dentition 2/2, 0/0, 0/0, 6/6 to 11/11: 1 genus.

**Trichechus** L. With the characters of the order: 2 species, one (*T. inunguis*) in the Amazon and Orinoco.

*T. latirostris* (Harlan). Manatee. Color uniform grayish black; extreme length 4500 mm.; extreme weight 1500 lbs; upper lip divided and very broad; eyes very small: east coast of Florida to Yucatan and the West Indias, in estuaries of broad rivers and coastal lagoons, where they feed on water plants; 1 or 2 young at a birth.

**Order 4. Insectivora.**—Moles and shrews. Small, mostly nocturnal mammals which live in or on the ground; feet plantigrade and usually

pentadactylous; canine teeth small; skull elongate; snout often prolonged to form a proboscis: about 9 families, 2 North American; widely distributed, one of the largest species being the European hedgehog.

**Key to the North American Families of Insectivora**

$a_1$ Fore feet very large and modified for digging; moles.....1. *Talpidæ.*
$a_2$ Fore feet not so modified; shrews.....2. *Soricidæ.*

**Family 1. Talpidæ.**—Moles. Body stout and cylindrical, covered by very soft fur; external ears absent; eyes very small and concealed in the fur; fore feet enormously enlarged and held vertically; neck not apparent; snout proboscis-like: about 20 species, 10 in the United States. Moles inhabit the Palearctic and Nearctic regions, living in burrows underground where they feed principally on earthworms and insect grubs. The nest is from 10 to 18 inches beneath the surface, and from it deep tunnels radiate. A second series of tunnels is made just beneath the surface, which appear as the familiar surface ridges which often disfigure lawns; they are made in search of food. A single litter of about 4 young is born in the spring time.

**Key to the United States Genera of Talpidæ**

$a_1$ In the eastern and central States.
  $b_1$ Tail very short.
    $c_1$ Tail slender and nearly naked; the common mole (Fig. 140)..1. *Scalopus.*
    $c_2$ Tail thick and very hairy (Fig. 140).....2. *Parascalops.*
  $b_2$ Tail long; snout with a star-shaped disc.....3. *Condylura.*
$a_2$ In the Pacific coast States.
  $b_1$ Large moles, over 150 mm. long...4. *Scapanus.*
  $b_2$ Small moles, under 125 mm. long..5. *Neurotrichus.*

FIG. 140.—The tail of (*a*) *Scalopus aquaticus* and (*b*) *Parascalops breweri.*

1. **Scalopus** Geoffroy. Adult dentition 3/3, 1/0, 3/3, 3/3; youthful dentition 3/3, 1/1, 3/3, 3/3; nostrils superior in position, being at the end of the snout, which is obliquely truncated; digits webbed: 2 species.

*S. aquaticus* (L.). Common mole (Fig. 140; Fig. 141). Body dark slate color, often tinged with brown; length 160 mm.; tail 27 mm.; hind foot 20 mm.: eastern and central States from Massachusetts and central Minnesota to Texas; westward to northeastern Colorado; very common; of considerable importance as a fur-bearing animal.

*Subspecies of S. aquaticus*

*S. a. aquaticus* (L.). Atlantic States from southern Massachusetts and southeastern New York to North Carolina and eastern Tennessee.

*S. a. howelli* Jackson. Color dark drab; length 152 mm.: eastern and central North Carolina and South Carolina southwesterly to the Mississippi and the Gulf coast.

*S. a. australis* (Chapman). Color clove-brown; length (male) 145 mm.: eastern Georgia and eastern Florida.

FIG. 141.—Lower jaw and fore foot of *Scalopus aquaticus* (*from Jackson*).

*S. a. anastasæ* (Bangs). Color sepia; length (male) 137 mm.: Anastasia Island, Florida.

*S. a. parvus* (Rhoads). Color dark sepia; length (male) 134 mm.: Tampa Bay, Florida.

*S. a. machrinus* (Rafinesque). Color sepia or brown; length 200 mm.: eastern Ohio to central Iowa and southern Minnesota; central Michigan to Tennessee.

*S. a. machrinoides* Jackson. Color brown; length 172 mm.: central Minnesota to Arkansas and eastern Kansas.

*S. a. pulcher* Jack. Color dark fuscous or brown; length (male) 155 mm: central Arkansas to southern Louisiana and eastern Texas.

*S. a. caryi* Jack. Color light drab; length (male) 159 mm.: western Nebraska and northwestern Kansas.

*S. a. intermedius* (Elliot). Color light drab; length 164 mm.: central and western Oklahoma.

*S. a. texanus* (Allen). Color brown; length 138 mm.: coast region of western Texas; northward to central Texas.

**2. Parascalops** True. Dentition 3/3, 1/1, 4/4, 3/3; nostrils lateral, on the outer side of the snout; digits not webbed; tail hairy: 1 species.

*P. breweri* (Bachman). Hairy-tailed mole (Fig. 140; Fig. 142). Body blackish, often with a brownish gloss; length 150 mm.; tail 30 mm.; hind foot 19: eastern States from New Brunswick to Georgia, in higher altitudes; westward to Ohio; in dry sandy soil; not common.

**3. Condylura** Illiger. Dentition 3/3, 1/1, 4/4, 3/3; snout terminating with a disc bearing on its margin a fringe of 22 long processes, 11 on each side; nostrils in the anterior surface of the disc; tail long, covered with coarse hair; digits not webbed: 1 species.

*C. cristata* (L.). Star-nosed mole (Fig. 143). Body blackish; length 185 mm.; tail 65 mm.; hind foot 28: southern Labrador to southeastern Manitoba; southward to central Ohio and Indiana west of the Alleghenies and to Georgia on the Atlantic slope; in wet meadows and marshes, frequently leaving its burrows and running on the surface; not common; annual litter of 5 young.

FIG. 142.—Fore foot of *Parascalops breweri* (*from Jackson*).

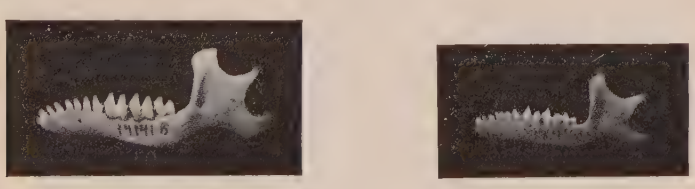
**4. Scapanus** Pomel. Dentition 3/3, 1/1, 4/4, 3/3; nostrils crescentic in shape, superior in position; tail short, thick, scantily haired; digits

FIG. 143.—Snout of *Condylura cristata* (*from Jackson*).

not webbed: several species, all on the Pacific slope, where they take the place of *Scalopus* in the eastern States and have similar habits.

**Key to the Species of Scapanus**

$a_1$ Unicuspid teeth evenly spaced and not crowded (Fig. 144); color very dark.
  $b_1$ Length more than 200 mm. ..... *S. townsendi.*
  $b_2$ Length less than 200 mm. ..... *S. orarius.*
$a_2$ Unicuspid teeth unevenly spaced and crowded (Fig. 144); color usually brown or gray, seldom black ..... *S. latimanus.*



*a* *b*

FIG. 144.—Lower jaw of (*a*) *Scapanus townsendi* and (*b*) *S. latimanus* (*from Jackson*).

*S. townsendi* (Bachman) (Fig. 144). Body of large size and blackish in color; length 225 mm.; tail 41 mm.; hind foot 26 mm.: northwestern California, Oregon and Washington, between the Cascades and the Coast Range; common; annual litter of 1 to 4 young.

*S. orarius* True. Body blackish or grayish in color; length 167 mm.; tail 33 mm.; hind foot 20 mm.: Washington, Oregon and northern California.

*Subspecies of S. orarius*

*S. o. orarius* True. Color fuscous black: coast region of Washington, Oregon and northern California.

*S. o. schefferi* Jackson. Color gray: north-central Oregon to British Columbia.

*S. latimanus* (Bach.) (Fig. 144). Body usually fuscous black, gray or drab in color; length 173 mm.; tail 35 mm.; hind foot 23 mm.: southern Oregon and California; annual litter of 2 or 3 each.

*Subspecies of S. latimanus*

*S. l. latimanus* (Bach.). Color black in winter, brown in summer; length 170 mm.: western California from Santa Maria River to Oregon.

*S. l. occultus* Grinnell & Swarth. Color lighter: southern California, west of the deserts and south of Olancha.

*S. l. grinnelli* Jack. Color black; length 156 mm.: Inyo County, California.

*S. l. sericatus* Jack. Color black; length 170 mm.: Yosemite regon.

*S. l. minusculus* Bangs. Color in summer, brown; length 160 mim.: El Dorado County, California.

*S. l. dilatus* True. Color gray or drab; length 175 mm.: south-central Oregon and northeastern California.

*S. l. alpinus* Merriam. Color in summer, gray; length 188 mm.: Crater Lake, Oregon.

**5. Neurotrichus** Günther. Size very small; dentition 3/3, 1/1, 2/2, 3/3; snout terminating in a small disc in which are the laterally situated nostrils; digits not webbed: 1 species.

*N. gibbsi* (Baird). Body dark gray in color; length 113 mm.; tail 37 mm.; hind foot 15 mm.: British Columbia to Eureka, California, west of the Cascades and Sierra Nevada; in wet woods or meadows, often on the surface or under logs.

*Subspecies of N. gibbsi*

*N. g. hyacinthinus* Bangs. Size larger; color darker: coast region of California from Monterey to Eureka.

**Family 2. Soricidæ.**—Shrews. Body rather slender; neck distinct; snout elongate and proboscis-like; eyes and external ears normal, but small; feet pentadactylous, the fore feet not modified; fur soft and

silky; zygomatic arch of skull wanting: many species, which are found throughout the world, except in the Australian and South American regions; about 36 species and 6 genera in the United States. The shrews are among the smallest mammals. They live in shallow tunnels, in run-ways in moss and mold and under logs and brush, feeding on worms, grubs, snails, mice and other small animals, including one another, and are noted for their fierceness and voracity. They raise two or more litters of 6 to 10 each during the summer and fall, and do not hibernate.

**Key to the United States Genera of Soricidæ**

$a_1$ Tail long, being much longer than the head (Fig. 146).
- $b_1$ Body 100 mm. to 130 mm. long ..... 1. *Sorex.*
- $b_2$ Body about 150 mm. long ..... 2. *Neosorex.*
- $b_3$ Body about 85 mm. long ..... 3. *Microsorex.*

$a_2$ Tail short, being usually shorter than the head (Fig. 147).
- $b_1$ Teeth 32; size large ..... 4. *Blarina.*
- $b_2$ Teeth 30; size small ..... 5. *Cryptotis.*
- $b_3$ Teeth 28; size small ..... 6. *Notiosorex.*

**1. Sorex** L. Long-tailed shrews. External ears well developed, generally appearing above the fur and directed backwards; tail about as long as the body; dentition 4/2, 1/0, 2/1, 3/3: about 40 North American species, 22 in the United States.

*a* *b*

FIG. 145.—Upper jaw of *Sorex personatus: a*, lateral view; *b*, lower surface (*from Merriam*).

*S. personatus* Geoffroy. Common shrew (Fig. 145). Body brown above, gray beneath; length 100 mm.; tail 38 mm.; hind foot 12 mm.: New England to Alaska; southward to southern Pennsylvania, Tennessee and northern Nebraska, and in the higher Alleghenies into North Carolina; not in the southern Rockies and the Cascade-Sierra systems; Boreal and Transition zones; the commonest species.

*S. fontinalis* Hollister. Like *S. personatus*, but with a much shorter tail: District of Columbia and its neighborhood.

*S. dispar* Batchelder. Size large; body stout, slate-color; length 130 mm.; tail 60 mm.; hind foot 15 mm.: Adirondack and Catskill Mountains; West Virginia.

*S. richardsoni* Bachman. Color blackish, indistinctly tricolor; length 112 mm.; tail 40 mm.; hind foot 13 mm.: northern Wisconsin and Minnesota to the lower Mackensie Valley.

*S. fumeus* Miller. Smoky shrew. Body slate-color; length 115 mm.; tail 45 mm.; hind foot 14 mm.: northeastern States and Canada; westward to the Great Lakes; southward into the mountains of North Carolina.

*S. vagrans* Baird. Body dark chestnut brown in color; length 103 mm.; tail 43 mm.; hind foot 12 mm.: Rocky Mountain region from British Columbia into Arizona, and the Pacific slope southward to Monterey; very common.

*Subspecies of S. vagrans*

*S. v. vagrans* Baird. Western Washington, Oregon and northern California; northern Rockies.

*S. v. dobsoni* Merriam. Color grayish brown: Idaho, western Montana, Wyoming and Utah.

*S. v. monticola* Merr. Color sepia brown: Arizona.

*S. amœnus* Merr. Color sooty brown; length 103 mm.; tail 37 mm.; hind foot 12 mm.: Sierra Nevada Mountains, California.

*S. nevadensis* Merr. Color slate black, mixed with hoary; length 96 mm.; tail 39 mm.; hind foot 12 mm.: interior of the Great Basin.

*S. obscurus* Merr. Body dull sepia brown in color; length 108 mm.; tail 46 mm.; hind foot 12 mm.: mountain regions from British Columbia to Colorado, Utah and central California; common.

*S. longicaudus* Merr. Size large; tail long; color dark chestnut-brown above; length 131 mm.; tail 62 mm.; hind foot 15 mm.: Puget Sound to Alaska.

*S. bairdi* Merr. Color dull chestnut; length 129 mm.; tail 57 mm.; hind foot 15 mm.: Oregon coast, mouth of the Columbia.

*S. trowbridgei* Baird. Color blackish, slate or plumbeous; tail sharply bicolor; length 121 mm.; tail 51 mm.; hind foot 13 mm.: western Washington and Oregon.

*S. montereyensis* Merr. Color slate black; tail sharply bicolor; length 120 mm.; tail 52 mm.; hind foot 14 mm.: south-central California.

*S. ornatus* Merr. Color ash gray, indistinctly bicolor; length 108 mm.; tail 43 mm.; hind foot 13 mm.: mountains of southern California.

*S. californicus* Merr. Color ash gray, with a pepper and salt appearance; length 93 mm.; tail 34 mm.; hind foot 11 mm.; brain case very flat: central California.

*S. tenellus* Merr. Body pale ash gray; white beneath; tail bicolor; length 103 mm.; tail 42 mm.; hind foot 12 mm.; skull very narrow: central California and southward.

*Subspecies of S. tenellus*

*S. t. tenellus* Merr. Southeastern California.

*S. t. lyelli* Merr. Browner; tail darker: Tuolumne county, California.

*S. t. myops* Merr. Smaller; ears larger; color paler: White Mountains, California.

*S. t. nanus* Merr. Smaller; color darker: Larimer County, Colorado.

*S. longirostris* Bach. Body brown above; length 85 mm.; tail 28 mm.; hind foot 10 mm.: Washington, D. C. to Georgia; westward to southern Illinois; in swamps and wet places.

*S. fisheri* Merr. Color chestnut brown; length 108 mm.; tail 33 mm.; hind foot 12 mm.: Dismal Swamp, Virginia.

*S. pacificus* Coues. Color cinnamon rufous; length 150 mm.; tail 63 mm.; hind foot 17 mm.: coastal region of northern California and southern Oregon.

*S. leucogenys* Osgood. Color brownish drab; length 107 mm.; tail 38 mm.; hind foot 12 mm.: Beaver County, Utah.

**2. Neosorex** Baird. Similar to *Sorex;* hind feet adapted to swimming, being very long and broad and fringed with bristles; toes also fringed, the third and fourth united at base and slightly webbed: 5 species, 4 in the United States.

**Key to the Species of Neosorex**

$a_1$ In the north-central States.....*N. palustris.*
$a_2$ In the northeastern States.....*N. albibarbis.*
$a_3$ In the Rocky Mountain and Pacific States.
  $b_1$ In the Rockies and the Sierra Nevadas.....*N. navigator.*
  $b_2$ In western Oregon and Washington.....*N. bendiri.*

*N. palustris* (Richardson). Color seal brown; gray beneath; length 157 mm.; tail 68 mm.; hind foot 20 mm.: central Minnesota to the Rockies; northward to Hudson Bay; in marshy places.

*N. albibarbis* Cope. Marsh shrew (Fig. 146). Body blackish slate in color, sparingly mixed with white tipped hairs, and dusky beneath; length 154 mm.; tail 70 mm.; hind foot 19 mm.: eastern North America from the Pennsylvania mountains to Labrador; not common; in swamps and wet fields and woods; Hudsonian and Canadian zones.

*N. navigator* Baird. Body plumbeous above, whitish beneath; length 150 mm.; tail 72 mm.; hind foot 20 mm.: Rocky Mountains from

British Columbia to southern Colorado and the Sierra Nevadas; southward to Sequoia Park.

*N. bendiri* (Merriam). Color blackish brown above and below; length 150 mm.; tail 68 mm.; hind foot 20 mm.: western Oregon and Washington.

FIG. 146.—*Neosorex albibarbis* (*Rhoads*).

*Subspecies of N. bendiri*

*N. b. bendiri* (Merr.). Klamath Basin, Oregon, to Puget Sound.

*N. b. palmeri* (Merr.). Color glossy black; size larger: western Oregon.

*N. b. albiventer* (Merr.). Size larger; beneath whitish: Olympic Mountains.

**3. Microsorex** Coues. Similar to *Sorex;* body very small; inner side of canines and second and third incisors with a distinct secondary cusp; fourth upper incisor very small and nearly hidden: 4 species in America, 2 in the United States.

*M. hoyi* (Baird). Body brown in color; length 90 mm.; tail 32 mm.; hind foot 10 mm.: northern America from New England to British Columbia; southward to Wisconsin and northern New York; rare.

*M. winnemana* Preble. Color grayish brown; tail bicolor; length 78 mm.; tail 28 mm.; hind foot 9 mm.: northern Virginia; the smallest American mammal.

**4. Blarina** Gray. Short-tailed shrews. Body rather stout, somewhat mole-like; ears hidden in the fur; teeth tipped with chestnut; tail about as long as the head; dentition 4/2, 1/0, 2/1, 3/3:3 species, 2 in the United States.

*B. brevicauda* (Say). Mole shrew (Fig. 147). Body dark brown in color; length 127 mm.; tail 26 mm.; hind foot 16 mm.: eastern and central America; westward to western Nebraska; common in woods and fields, bogs and swamps; emits a fetid odor.

*Subspecies of B. brevicauda*

*B. b. brevicauda* (Say). Western Nebraska to Manitoba; eastward to the Mississippi River.

*B. b. aloga* Bangs. Smaller and paler; color brownish drab: Marthas Vineyard.

*B. b. compacta* Bangs. Color slaty gray; tail unicolor: Nantucket.

*B. b. carolinensis* (Bachman). Size smaller: southern States from Indiana and Maryland to Arkansas and Florida.

*B. b. hulophaga* Elliot. Smaller, lighter in color and with an extremely short tail: Oklahoma.

*B. b. peninsulæ* Merriam. Color more slaty; hind feet longer: Florida south of latitude 28.

*B. b. talpoides* (Gapper). Northeastern and central States; westward to the Mississippi; southward to Georgia and Tennessee.

*B. telmalestes* Merr. Similar to *B. brevicauda* but more plumbeous in color; length 118 mm.; tail 28 mm.; hind foot 16 mm.: Dismal Swamp, Virginia.

**5. Cryptotis** Pomel. Similar to *Blarina*, but much smaller; tail very short; dentition 3/2, 1/0, 2/1, 3/3: 18 species, all tropical but two.

*C. parva* (Say). Body brownish in color; length 79 mm.; tail 16 mm.; hind foot 10 mm.: eastern and central States, south of New York; westward to Nebraska and Texas; in meadows and fields; often rare.

*C. floridana* (Merriam). Color iron gray; length 89 mm.; tail 22 mm.; hind foot 22 mm.; similar to C. *parva*, but larger: Florida, south of latitude 29.

*C. berlandieri* (Baird). Color ash brown; length 83 mm.; tail 19 mm.; hind foot 12 mm.: coast of southern Texas and valley of the lower Rio Grande.

**6. Notiosorex** Baird. Body very small; tail short; dentition 3/2, 1/0, 1/1, 3/3: 1 species.

*N. crawfordi* (Baird). Color olive gray; beneath whitish; length 82 mm.; tail 26 mm.; hind foot 10 mm.: eastern Texas to southern California.

FIG. 147.—*Blarina brevicauda* (Rhoads).

**Order 5. Chiroptera.**—Bats. Small, flying mammals in which the greatly elongated fore limbs form the supports of the wings. These consist of a paired integumental membrane which extends between the arms and the four fingers and the body, and includes the hind legs and the tail. The knee bends backwards. The portion of the membrane between the hind legs which incloses the tail is called the *interfemoral*

*membrane*. The thumb is not included in the wing membrane. The foot has 5 digits; a long spur extends from the heel along the base of the interfemoral membrane. The ear is large and bears an elongated lobe in its concavity called the *tragus* (Fig. 148). In many families, at the end of the snout and surrounding the nostrils is a series of more or less complicated membranes called the *nose-leaf* (Fig. 148). The mammæ are thoracic in position and number 1 or 2 pairs. The sternum bears a keel.

The order contains about 900 species, grouped in 2 suborders, one of which, the *Megachiroptera*, or the frugivorous flying foxes of India and Australia, is not represented in this country.

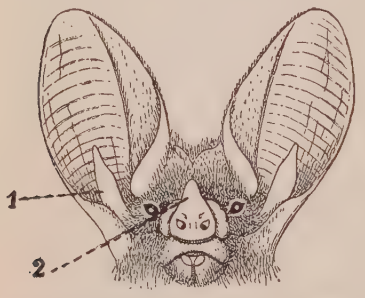



FIG. 148.—Head of *Microtus californicus:* 1, tragus; 2, nose-leaf (*from Allen*).

**Suborder Microchiroptera.**—Bats with a short snout, large ears and multicuspid molar teeth: 16 families and about 600 species, 3 families and about 30 species occurring in the United States. Bats are nocturnal animals, which feed mostly on beetles, mosquitoes and other night-flying insects, which they chew before swallowing. Some species are, however, frugivorous and some sanguivorous. The female of most species bears one or two at a birth, which she may carry about with her, clinging to her body until they are old enough to be left in some safe place. Bats spend the day in caves and other dark places, hanging head downward by the hind feet. In the winter they hibernate or migrate.

**Key to the United States Families of the Microchiroptera**

$a_1$ Third finger with 3 phalanges; nose-leaf present; only in the extreme south ..... 1. *Phyllostomidæ.*
$a_2$ Third finger with 2 phalanges; nose-leaf absent.
  $b_1$ Ear with tragus; all United States bats, with a few exceptions ..... 2. *Vespertilionidæ.*
  $b_2$ Ear without tragus; in the extreme southwest ..... 3. *Molossidæ.*

**Family 1. Phyllostomidæ.**—American leaf-nosed or vampire bats. Nose usually with a nose-leaf; tragus present; wing membrane reaching to the ankle; tail usually long, extending beyond the interfemoral membrane; lower lip cleft: about 50 genera, all South and Central American, 3 species occurring along the southern border of the United States. The family includes the large fruit-eating vampire of South

America (*Vampyrus spectrum*), whose horrid aspect has given it the undeserved reputation of being a blood-sucker. The true blood-sucking bats of South America are of small size and belong to the genera *Desmodus* and *Diphylla* of this family.

**1. Mormoops** Leach. Crown of head greatly elevated above face; dentition 2/2, 1/1, 2/3, 3/3; nose-leaf absent: 2 species, 1 in the United States.

*M. megalophylla senicula* Rehn. Body brown in color; length 90 mm.; tail 28 mm.; forearm 56 mm.: southern Texas to Ecuador.

**2. Macrotus** Gray. Dentition 2/2, 1/1, 2/3, 3/3; head elongate; nose-leaf simple: 4 species, 1 in the United States.

*M. californicus* Baird (Fig. 148). Body pale brownish gray in color; length 88 mm.; tail 33 mm.; ears very large: arid regions of southwestern United States and of Mexico.

**3. Artibeus** Leach. Dentition 2/2, 1/1, 2/2, 2/3 or 3/3; nose-leaf well developed; no external tail: 9 species, 1 in the United States.

*A. jamaicensis parvipes* Rehn. Body brown or gray in color; length 70 mm.; forearm 52 mm.: West Indias and Central America, occasionally in Florida.

**Family 2. Vespertilionidæ.**—Mostly small bats with a large tragus and a long tail which is either entirely or mostly enclosed in the interfemoral membrane; no nose-leaf; molars with distinct W-shaped cusps; bony palate defective: 260 species, of cosmopolitan distribution, including, with a few exceptions, all of the bats occurring in the United States; 2 subfamilies.

**Key to the United States Subfamilies of Vespertilionidæ**

$a_1$ Lower incisors 6; snout without ridge ..... 1. *Vespertilioninæ.*
$a_2$ Lower incisors 4; horseshoe-shaped ridge on snout ..... 2. *Nyctophilinæ.*

*Subfamily* 1. *Vespertilioninæ.* Bats with a simple snout and nostrils, with 6 lower incisors and ears usually not joined in front: over 20 American species.

**Key to the United States Genera of Vespertilioninæ**

$a_1$ Ears not united in front.
  $b_1$ Upper incisors 4 (both sides) (Fig. 149).
    $c_1$ Upper premolars 3 (on each side) (Fig. 149) ..... 1. *Myotis.*
    $c_2$ Upper premolars 2.
      $d_1$ Lower premolars 3 ..... 2 *Lasionycteris.*
      $d_2$ Lower premolars 2 ..... 3. *Pipistrellus.*
    $c_3$ Upper premolars 1 ..... 4. *Eptesicus.*
  $b_2$ Upper incisors 2 (both sides).

$c_1$ Upper premolars 2 (on each side).....5. *Nycteris.*
$c_2$ Upper premolars 1.
$d_1$ Mandibular tooth-row more than 8 mm. long.....6. *Dasypterus.*
$d_2$ Mandibular tooth-row less than 7 mm. long.....7. *Nycticeius.*
$a_2$ Ears very large and united at base in front.
$b_1$ Nostrils simple.....8. *Euderma.*
$b_2$ Nostrils with a high ridge behind each.....9. *Corynorhinus.*

1. **Myotis** Kaup. Small, slender bats with a long tail, a hairy face and narrow ears; dentition 2/3, 1/1, 3/3, 3/3: 80 species, cosmopolitan; 12 species in the United States.

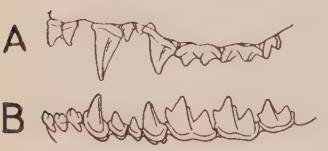



FIG. 149.—Teeth of *Myotis lucifugus: A*, left side of upper jaw; *B*, left side of lower jaw (*from Miller*).

*M. lucifugus* (LeConte). Little brown bat (Fig. 149). Body brown in color; length 87 mm.; tail 38 mm.; fore arm 38; ears short and broad and when laid forward reach about to the nostrils: entire United States, except the coastal regions of the Pacific slope north of Puget Sound; common, especially towards the south.

### *Subspecies of M. lucifugus*

*M. l. lucifugus* (LeC.). Entire country, except the Rocky Mountains and the Pacific coast.

*M. l. longicrus* (True). Body larger: Puget Sound region and eastward to Wyoming and southward to Arizona and southern California.

*M. subulatus* (Say). Color light brown; length 85 mm.; tail 38 mm.; fore arm 35 mm.; ears slender and when laid forward reaching considerably beyond tip of nose: North America, east of the Rockies; common; number of young at a birth 2.

*M. velifer* (J. A. Allen). Color dull sepia; length 95 mm.; tail 44 mm.; forearm 41 mm.; ears short, reaching to the nostril when laid forward: the Mexican border.

*M. incautus* (J. A. A.). Like *M. velifer* but with a more pallid coloration: San Antonio, Texas.

*M. baileyi* Hollister. Like *M. velifer* but smaller: White Mountains, New Mexico.

*M. grisescens* Howell. Like *M. velifer* but darker: Marion County, Tennessee.

*M. occultus* Holl. Color glossy brown; length 96 mm.; tail 40 mm.: San Bernardino County, California.

*M. carissima* Thomas. Color blackish; length 81 mm.; tail 36 mm.: Yellowstone Lake, Wyoming.

*M. californicus* (Audubon & Bachman). Body slender and very small, with a long tail and legs; color yellowish gray; wings, ears and snout blackish; fur very long; length 78 mm.; tail 38 mm.; forearm 31 mm.; western United States; eastward to Texas and Kansas: common.

*Subspecies of M. californicus*

*M. c. californicus* (Aud. & Bach.). Western United States; eastward to Wyoming and Texas.

*M. c. caurinus* Miller. Very much darker in color: coast district, northern California to British Columbia.

*M. c. ciliolabrum* (Merriam). Very much paler in color: Kansas to central South Dakota.

*M. yumanensis* (H. Allen). Body small, whitish gray or brown in color; length 80 mm.; tail 36 mm.; forearm 34 mm.; feet very large: western United States, west of the mountains.

*Subspecies of M. yumanensis*

*M. y. yumanensis* (H. A.). Southwestern States from Utah to southern California.

FIG. 150.—Teeth of *Lasionycteris noctivagans*, the upper jaw at the left (*from Miller*).

*M. y. saturatus* Miller. Color much darker: central Oregon to British Columbia.

*M. evotis* (H. Allen). Long-eared bat. Color light yellowish brown; length 90 mm.; tail 42 mm.; forearm 37; ears very long, reaching 7 to 10

FIG. 151.—Teeth of *Pipistrellus hesperus* (above) and *P. subflavus* (below), the upper jaw at the left (*from Miller*).

mm. beyond the tip of the nose when laid forward: western States; eastward to the eastern edge of the Rocky Mountains.

**2. Lasionycteris** Peters. Medium sized bats with short, broad ears and a broad tragus; dentition 2/3, 1/1, 2/3, 3/3: 1 species.

*L. noctivagans* (LeConte). Silver-haired bat (Fig. 150). Color deep brown-black, the back with a silvery sheen; length 100 mm.; tail

41 mm.; forearm 42 mm.: North America, north of Mexico; common.

**3. Pipistrellus** Kaup. Small bats, similar to *Myotis;* dentition 2/3, 1/1, 2/2, 3/3: 40 species, 2 in the United States.

**Key to the United States Species of Pipistrellus**

$a_1$ Tragus blunt, with tip bent forward..... *P. hesperus.*
$a_2$ Tragus tapering and straight..... *P. subflavus.*

*P. hesperus* (H. Allen) (Fig. 151). Color light yellowish gray; length 75 mm.; tail 32 mm.; forearm 30 mm.: southern and western Texas to the Pacific.

*P. subflavus* (F. Cuvier) (Fig. 151). Color light yellowish brown; length 85 mm.; tail 40 mm.; forearm 34 mm.: eastern United States; westward to Iowa and Texas; Austral zone.

*Subspecies of P. subflavus*

*P. s. subflavus* (F. Cuv.). Eastern United States.

*P. s. obscurus* Miller. Color duller and less yellow: eastern and central New York (Lake George).

FIG. 152.—Teeth of *Eptesicus fuscus*, the upper jaw at the left (*from Miller*).

**4. Eptesicus** Rafinesque (*Vespertilio* L.). Dentition 2/3, 1/1, 1/2, 3/3; interfemoral portion of membrane naked: 5 species, 1 in the United States.

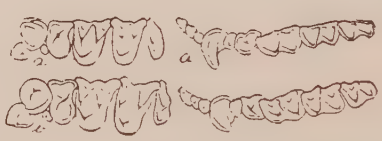


FIG. 153.—Teeth of *Nycteris borealis: a, N. b. teliotis; b, N. b. borealis*, the upper jaw at the left (*from Miller*).

*E. fuscus* (Beauvois). Big brown bat; house-bat (Fig. 152). Color sepia brown; length 110 mm.; tail 45 mm.; forearm 45 mm.: United States and Mexico; common.

*Subspecies of E. fuscus*

*E. f. fuscus* (Beauv.). Size large: United States.

*E. f. osceola* Rhoads. Color deeper and darker: Hillsboro County, Florida.

*E. f. bernardinus* Rhoads. Size large; wings and ears very dark: San Bernardino, California.

*E. f. melanopterus* Stone. Color more reddish: Eldorado County, California.

**5. Nycteris** Borkhausen (*Lasiurus* Gray). Dentition 1/3, 1/1, 2/2, 3/3; interfemoral portion of membrane densely furred; ears short and round: 12 species, 2 in the United States; these are unusually tolerant of sunlight, often roosting in trees during the day in the full glare of the sun and beginning to feed in the afternoon; number of young 2 to 4.

*N. borealis* (Müller). Red bat (Fig. 153). Body varying from rufous red to yellowish gray in color, with a white spot on each shoulder, the two spots connected by a white chest band; length 110 mm.; tail 50 mm.; forearm 40 mm.: eastern and central North America; common.

*Subspecies of N. borealis*

*N. b. borealis* (Müller). West to Oklahoma and Colorado.

*N. b. seminola* (Rhoads). Color mahogany brown, slightly grayish: South Carolina to southern Texas.

FIG. 154.—Teeth of *Dasypterus intermedius*, the upper jaw at the left (*from Miller*).

*N. b. teliotis* (H. Allen). Size smaller; color redder: central and southern California.

*N. cinerea* (Beauvois). Hoary bat. Body gray in color; length 135 mm.; tail 50 mm.; forearm 40 mm.; wings long and pointed: northern North America; southward to central New York, migrating in winter into the southern States.

**6. Dasypterus** Peters. Dentition 1/3, 1/1, 1/2, 3/3; dorsal portion of interfemoral membrane furred on basal half only; ears higher than broad: 3 species in Mexico and the United States.

*D. intermedius* (H. Allen) (Fig. 154). Color light yellowish brown; length 145 mm.; tail 65 mm.; forearm 55 mm.: Gulf States and northern Mexico.

*D. floridanus* Miller. Color light yellowish brown; length 129 mm.; tail 52 mm.; forearm 49 mm.: Gulf coast from Florida to Louisiana.

**7. Nycticeius** Rafinesque. Dentition 1/3, 1/1, 1/2, 3/3; interfemoral portion of membrane furred at the base only; ears short: 2 species, 1 in Cuba.

*N. humeralis* (Raf.). Body dull brown in color; length 90 mm.; tail 36 mm.; forearm 36 mm.; ear small, with a short, blunt tragus: southeastern and central States; northward to Pennsylvania; westward to Arkansas; Austral zone.

**8. Euderma** H. Allen. Dentition 2/3, 1/1, 2/2, 3/3; ears joined across the forehead: 1 species.

*E. maculatum* (J. A. Allen). Color dark sepia, almost black above; length 110 mm.; tail 50 mm.; forearm 50 mm.: southern California, Arizona and New Mexico; rare.

**9. Corynorhinus** H. Allen. Dentition 2/3, 1/1, 2/3, 3/3; a pair of large glandular masses on the snout, rising high above the nostrils; ears very large and united at their anterior base: 1 species.

*C. macrotis* (LeConte). Big-eared bat. Body large, yellowish brown in color, distinctly bicolor; length 105 mm.; tail 52 mm.; forearm 43 mm.; ear 33 mm.: southern United States, from one coast to the other; also in the extreme northwest.

*Subspecies of C. macrotis*

*C. m. macrotis* (LeC.). Eastern States; Lower Austral one.

*C. m. pallescens* Miller. Color much paler, nowhere distinctly bicolor: southwestern States from southern California to western Texas and Colorado.

*C. m. townsendi* (Cooper). Color much darker, nowhere distinctly bicolor: coast district of Oregon and Washington.

**Subfamily 2. Nyctophilinæ.**—Bats with a horseshoe-shaped ridge around the nostrils and with 4 lower incisors: 1 genus.

**Antrozous** H. Allen. Dentition 1/2, 1/1, 1/2, 3/3; mammæ 2: 2 species, 1 in Lower California.

*A. pallidus* (LeConte). Body pale drab in color; length 105 mm.; tail 45 mm.; forearm 53 mm.; ears very large, extending 20 mm. beyond the nose when laid forwards: southwestern States from western Texas to the Pacific.

FIG. 155.—Head of *Nyctinomus cynocephalus* (*from Allen*).

**Family 3. Molossidæ.**—Wings long and narrow, thick and leathery; no tragus; legs short and stout; nostrils usually on a special pad: about 80 species, in the warmer parts of the earth.

**Nyctinomus** Geoffroy. Head and body flattened; dentition 1/2 or 1/3, 1/1, 2/2, 3/3; ears large, rounded, extending beyond the snout when laid forwards, nearly united on the top of the head: 40 species, 16 American, 2 in the United States.

*N. cynocephalus* (LeConte). Mexican bat (Fig. 155). Body plumbeous or dusky brown in color; length 79 mm.; tail 30 mm.; forearm 40 mm.; sides of snout with a series of deep wrinkles; half of tail in interfemoral membrane: southern States; common.

**Order 6. Carnivora.**—The flesh-eaters. Carnivorous, sometimes omnivorous mammals with large projecting canine teeth, cutting premolars and tuberculate molars; the last upper premolar and the first lower molar being carnassial (flesh-cutting) teeth (Fig. 139); digits unguiculate and never less than 4: 250 species, 120 in the United States, grouped in 5 families; predatory mammals distributed throughout the world.

**Key to the Families of Carnivora**

$a_1$ Claws not retractile.
  $b_1$ Tail rudimentary; bears.....1. *Ursidæ.*
  $b_2$ Tail well developed and long.
    $c_1$ Feet digitigrade; hind foot with 4 toes; wolves; foxes...2. *Canidæ.*
    $c_2$ Feet plantigrade; hind foot with 5 toes; racoons.....3. *Procyonidæ.*
$a_2$ Claws more or less retractile.
  $b_1$ Hind foot with 5 toes; weasels; skunks.....4. *Mustelidæ.*
  $b_2$ Hind foot with 4 toes; cats.....5. *Felidæ.*

**Family 1. Ursidæ.**—Bears. Body of large size, thick and heavy; feet plantigrade; toes 5-5; claws not retractile: in all geographical regions except the Ethiopean and Australian; 2 genera, one of which, *Thalarctos* Gray, includes the Polar bear, *T. maritimus* (Phipps).

**Ursus** L. Head short and broad; snout depressed; dentition 3/3, 1/1, 4/4, 2/3; molars very broad and tuberculate: many species, about 3 in the United States, omnivorous, mainly nocturnal animals which hibernate in the winter. The young, from 1 to 4 in number, are born in midwinter. The brown bears of Alaska and Arctic America, of which many species have been described, are characterized by their great size, *U. middendorffi* being the largest and heaviest of the *Carnivora.*

**Key to the United States Species of Ursus**

$a_1$ Size moderate; length under 1,700 mm.
  $b_1$ Color black, sometimes brown.....*U. americanus.*
  $b_2$ Color brown or yellowish; in Louisiana and Texas.....*U. luteolus.*
$a_2$ Size very large; length over 1,700 mm.....*U. horribilis.*

*U. americanus* Pallas. Black bear; cinnamon bear. Body black, with a brown muzzle, or entirely brown, there being two color phases, the cinnamon bear of the northern Rockies being the brown phase;

length 1,540 mm.; tail 120 mm.; weight up to 500 lbs.: forest lands of North America north of the Gulf States and the Sierra Madre in Mexico; Hudsonian, Canadian, Transition and Upper Austral zones; climbs trees readily.

*Subspecies of U. americanus*

*U. a. americanus* Pal. North America.

*U. a. amblyceps* Baird. Color brown: southern Texas, New Mexico and Arizona.

*U. a. floridanus* Merriam. Head very long, high and narrow: southern Florida.

*U. luteolus* Griffith. Color yellowish brown, darker on the nape; similar to *U. americanus*, but with a long, flattened skull: Louisiana and eastern Texas.

*U. horribilis* Ord. Grizzly bear. Color brownish yellow, being darker on the back and legs; fur long and shaggy; length 2,500 mm.; weight up to 1,000 lbs.: western America from Mexico, New Mexico and Arizona to Alaska and Hudson Bay; does not climb trees, except when a cub.

*Subspecies of U. horribilis*

*U. h. horribilis* Ord. Utah and northward.

*U. h. horriæus* Baird. Size smaller; the frontal bones flattened and concave between the postorbital processes: New Mexico and Arizona to Utah and Colorado.

*U. h. californicus* Merr. Size large; ears longer: central and southern California.

**Family 2. Canidæ.**—Dogs, wolves and foxes. Body slender, with long legs; feet digitigrade; toes 5-4; claws blunt and non-retractile; head elongate; dentition 3/3, 1/1, 4/4, 2/3 (Fig. 139): cosmopolitan; about 50 species in North America.

**Key to the United States Genera**

$a_1$ Pupil round; dogs and wolves.....1. *Canis.*
$a_2$ Pupil elliptical; tail bushy; foxes.
  $b_1$ Tail with soft under-fur.....2. *Vulpes.*
  $b_2$ Tail with coarse fur.....3. *Urocyon.*

1. **Canis** L. Dogs and wolves. Legs long; tail moderately bushy; upper incisors distinctly lobed: many species; cosmopolitan; about 24 in North America, and 15 in the United States. The domestic dog, *C. familiaris*, is descended from a number of wild stocks. The native

wild dogs and wolves fall into 2 groups or subgenera, one of which is *Canis* L. and has for its characteristic representative the gray wolf, and the other is *Lyciscus* Hamilton Smith, which is represented by the cayote. They are very prolific, wolves having sometimes as many as 12 young at a birth and cayotes as many as 14.

**Key to the United States Species of Canis**

$a_1$ Size large; wolves; length mostly over 1,400 mm.
- $b_1$ East of the Mississippi.
  - $c_1$ In the northeastern States..... *C. lycaon.*
  - $c_2$ In the southern States..... *C. floridanus.*
- $b_2$ West of the Mississippi.
  - $c_1$ On the Great Plains and in Rocky Mountains; tail short... *C. nubilus.*
  - $c_2$ In the Puget Sound region..... *C. gigas.*
  - $c_3$ In Texas..... *C. frustror.* *C. rufus.*

$a_2$ Size smaller; cayotes; length under 1,200 mm.; muzzle sharp.
- $b_1$ On the northern prairies..... *C. latrans.*
- $b_2$ On the Great Plains..... *C. nebracensis.*
- $b_3$ In the mountains and the Great Basin..... *C. lestes.*
- $b_4$ In the southwest.
  - $c_1$ In the lower Rio Grande Valley..... *C. microdon.*
  - $c_2$ In Arizona..... *C. mearnsi.*
  - $c_3$ From eastern California to Utah..... *C. estor.*
  - $c_4$ In the San Joaquin Valley..... *C. ochropus.*

*C. lycaon* Schreber (*C. occidentalis* Richardson). Gray wolf. Color gray, mixed with blackish or tawny; length 1,465 mm.; tail 405 mm.; hind foot 225 mm.: eastern Canada and northeastern United States; exterminated, except towards the north.

*C. floridanus* Miller. Southern wolf. Similar to *C. lycaon*, but much darker; color black above, buffy gray faintly clouded on the sides and beneath; muzzle and legs yellowish: Florida.

*C. nubilus* Say. Gray wolf of the plains; lobo; timber wolf. Color gray, varying to blackish on the back and tawny on the belly; length 1,365 mm.; tail 273 mm.; weight about 100 lbs.: the interior States and central Canada; southward to Nebraska and California; exterminated in well settled districts, but common in many places in the Great Plains and Rocky Mountains.

*C. frustror* Woodhouse. American jackal. Color gray, clouded with black; length 1,143 mm.; tail 355 mm.; hind foot 180 mm.: Texas and Oklahoma.

*C. gigas* Townsend. Northwest timber wolf. Size large; tail very short; color black above, reddish brown on the sides, cinereous below: region of Puget Sound.

*C. rufus* Audubon & Bachman. Texas red wolf. Color reddish brown mixed with irregular patches of black; upper surface and end of tail black; length 1,200 mm.; tail 325 mm.; form slender; fur smooth: southwestern Texas.

*C. latrans* Say. Cayote; prairie wolf. Color fulvous or grayish, clouded with black; tail tipped with black; muzzle sharp; length 1,219 mm.; tail 394 mm.; hind foot 179 mm.; weight about 25 lbs.: humid prairies and woodlands of northern Mississippi Valley, in Iowa and Minnesota and westward to the Rockies in Alberta.

*C. nebracensis* Merriam. Plains cayote. Similar to *C. latrans*, but a little smaller and paler; upper parts whitish, sparingly mixed with black hairs; under parts white: Great Plains from Canada to Texas.

*Subspecies of C. nebracensis*

*C. n. nebracensis* Merr. Nebraska and eastern Colorado to Montana and Canada.

*C. n. texensis* Bailey. Color darker and brighter: Texas and Oklahoma.

*C. lestes* Merr. Mountain cayote. Size large, but somewhat smaller than *C. latrans;* color similar but darker; ears and tail large: highlands and mountains of the Great Basin and Rockies and the Sierra Nevada from British Columbia to Mexico.

*C. microdon* Merr. Color cinnamon rufous; length 1,070 mm.; tail 320 mm.; hind foot 186 mm.; teeth very small; hind foot whitish above: lower Rio Grande region.

*C. mearnsi* Merr. Similar to *C. microdon* in size; color fulvous and very rich and bright: Arizona.

*C. estor* Merr. Similar to *C. mearnsi* in size and color, but paler, being a pale desert form: eastern California, Nevada and Utah.

*C. ochropus* Eschscholtz. Similar to *C. latrans*, but smaller and darker; ears large; head small: San Joaquin Valley, California.

**2. Vulpes** Oken. Red foxes. Upper incisors not lobed; legs rather short; tail bushy, with soft under-fur: about 20 species, all in the northern hemisphere, 10 in the United States, all valuable fur-bearing animals. Their dens are holes in the ground dug by themselves, and they bear 4 to 9 at a birth.

**Key to the United States Species of Vulpes**

$a_1$ In the eastern and central States.
  $b_1$ In the States east of the Mississippi..... *V. fulva.*
  $b_2$ In Nova Scotia and Labrador..... *V. rubicosa.*

$b_3$ In Newfoundland.....*V. deletrix.*
$a_2$ In the western States.
$b_1$ On the Great Plains.
$c_1$ In the northern States and Canada.....*V. regalis.*
$c_2$ In the central Mountain States.....*V. velox.*
$c_3$ In the southwestern deserts.....*V. macrotis.*
$b_2$ In the mountains.
$c_1$ In the central Rockies.....*V. macrourus.*
$c_2$ In the Sierras and Cascades.....*V. cascadensis.*
$c_3$ In the high Sierras.....*V. necator.*
$b_3$ In central California.....*V. mutica.*

*V. fulva* (Desmarest). Red fox; black fox; cross fox; silver gray fox. Color reddish gray; feet and ears black; tail darker than body; tip of tail and under parts white; melanic individuals sometimes occur, the black fox being entirely black, the cross fox having a black band along the back crossed by one on the shoulders, and the silver fox being silver gray; length 1,034 mm.; tail 394; hind foot 163: eastern America, southward to Georgia and Tennessee; northward to Maine; westward to the Great Plains; introduced into other regions.

*V. rubricosa* Bangs. Size slightly larger and color deeper than *V. fulva;* tail very dark, with a basal ring of black: Nova Scotia and Labrador.

*V. deletrix* Bangs. Size slightly smaller than *V. fulva;* hind feet and claws very large; color very pale, being light straw: Newfoundland.

*V. regalis* Merriam. Size much larger than *V. fulva*, the length being 1,117 mm.; ears very broad and large; tail very long but thin; color golden yellow; legs abruptly reddish; feet black: northern plains from Minnesota to Montana and Alberta.

*V. macrourus* Baird. Size and color of *V. fulva,* but tail much longer and hind feet larger: Nebraska to Oklahoma; mountains of Colorado, Utah and Wyoming.

*V. velox* (Say). Swift fox; kit fox. Size small; length 645 mm.; tail 226 mm.; hind foot 95 mm.; color yellowish gray above and white underneath; tip of tail black: northern Texas through Nebraska and eastern Colorado into Alberta; not common.

*V. necator* Merr. Size and color of *V. fulva:* high Sierras, California.

*V. cascadensis* Merr. Color similar to *V. fulva;* black-cross color phase common; length 1,070 mm.; tail 412 mm.; hind foot 178 mm.: northern Sierras, Cascades and northward.

*V. mutica* Merr. Similar to *V. macrotis;* top of head and middle of back reddish brown; outside of hind foot fulvous; tip of tail black; length 950 mm.; tail 350 mm.; hind foot 122 mm.: San Joaquin Valley, California.

*V. macrotis* Merr. Long eared fox; desert fox. Length 850 mm.; tail 290 mm.; hind foot 110 mm.; color grizzled gray above; sides fulvous; under parts white, mixed with buff; terminal quarter of tail black; ears well haired, very long and broad; tail long and slender: Mexican border from Texas to California.

**3. Urocyon** Baird. Gray foxes. Upper incisors not lobed; tail with concealed stiff hairs and no soft under-fur: 7 species, 5 in the United States and 2 in Central America, being most numerous in the semiarid regions of the southwest; they do not dig a den, as do the red foxes, but live in hollow logs or in cavities in the rocks; the young number from 3 to 9.

**Key to the Species of Urocyon**

| | |
|---|---|
| $a_1$ In the eastern and central States | *U. cinereoargenteus.* |
| $a_2$ On the Pacific slope. | |
| $b_1$ On the main land | *U. californicus.* |
| $b_2$ On the islands off the coast | *U. clementæ.* |
| | *U. catalinæ.* |
| | *U. littoralis.* |

*U. cinereoargenteus* (Schreber). Gray fox. Color gray, darker on the back; sides of neck, collar and a band along belly tawny; feet and tip of tail black; under parts whitish; length 900 mm.; tail 260 mm.; hind foot 125 mm.: northern America south of southern New York and central New England, from the Atlantic to southern California.

*Subspecies of U. cinereoargenteus*

*U. c. cinereoargenteus* (Schreber). Eastern States; southward to Georgia; westward to the Mississippi Valley and Lake Michigan.

*U. c. borealis* Merriam. Size larger; fourth lower premolar very large: southern New Hampshire.

*U. c. floridanus* Rhoads. Size small; fur coarse; no white beneath: Florida and southern Georgia.

*U. c. ocythous* Bangs. Size large; color with more yellow: upper Mississippi Valley north of Tennessee; westward to the plains.

*U. c. texensis* Mearns. Colors pale; ears larger; tail longer: southwestern Texas.

*U. c. scotti* Mearns. Tail and ears very long; color pale: Texas to southern California.

*U. c. inyœnsis Elliot.* Color very pale: Inyo County, California.

*U. californicus* Mearns. Similar to *U. cinereoargenteus*, but smaller and paler and with larger ears and a longer tail; length 890

mm.; tail 330 mm.; hind foot 120 mm.: southern California to Washington.

*Subspecies of U. californicus*

*U. c. californicus* Mearns. Southern California.

*U. c. sequoiensis* Dixon. Central California.

*U. c. townsendi* Merr. Tawny tints darker; ears smaller: northern California.

*U. clementæ* Merr. Length 688 mm.; tail 250 mm.; hind foot 100 mm.; under side of thigh and upper side of hind foot whitish: San Clemente Island, California.

*U. catalinæ* Merr. Length 795 mm.; tail 298 mm.; hind foot 112 mm.; white on under side of thigh greatly restricted: Catalina Island, California.

*U. littoralis* (Baird). Length 708 mm.; tail 260 mm.; hind foot 109 mm.: San Miguel and Santa Cruz Islands, California.

**Family 3. Procyonidæ.**—Racoons. Body of small or medium size, stout and bear-like; feet plantigrade; claws not retractile; toes 5-5; tail well developed; teeth 3/3, 1/1, 4/4, 2/2: about 7 genera, all American, 3 genera and 5 species in the United States.

**Key to the Genera of the Procyonidæ in the United States**

$a_1$ Body stout.....1. *Procyon.*
$a_2$ Body elongate and slender.
  $b_1$ Snout not proboscis-like.....2. *Bassariscus.*
  $b_2$ Snout proboscis-like.....3. *Nasua.*

**1. Procyon** *Storr.* Body stout; head rather short; snout pointed; tail rather short and ringed with black and white: 8 species, ranging from northern South America to Canada; 3 species in the United States.

*P. lotor* (L.). Racoon; coon. Color gray, the hairs being yellowish-brown tipped with black; tail ringed with white and black; a black-patch on cheek; fur rather coarse; length 830 mm.; tail 250 mm.; hind foot 120 mm.; weight about 20 lbs.: United States east of the Rockies. Racoons are nocturnal, forest animals, frequenting the vicinity of water-courses. They are omnivorous in their feeding habits and make their nests mostly in hollow trees, in which they have from 4 to 6 young annually; in the north they hibernate, but not in the south.

*Subspecies of P. lotor*

*P. l. lotor* (L.). United States north of Florida and Texas.

*P. l. elucus* Bangs. Color distinctly yellow: Gulf coast.

*P. l. mexicanus* Baird. Size large; color pale; tail long: western Texas; New Mexico, Arizona and Utah; southward into southern Mexico.

*P. l. hernandezi* Wagler. Size very large; black tail-rings very narrow: western Mexico and into Arizona and southern California.

*P. pallidus* Merriam. Color pale gray, with no yellowish; length 855 mm.; tail 295 mm.; hind foot 128 mm.: southern California; a desert form.

*P. psora* Gray. Size large; length 940 mm.; tail 310 mm.; hind foot 115 mm.; color dark grizzled gray: Pacific slope.

*Subspecies of P. psora*

*P. p. psora* Gray. California.

*P. p. pacifica* Merriam. Color much darker; black rings on tail continuous below: northern California, Oregon and Washington.

**2. Bassariscus** Coues. Body slender; head short; muzzle pointed; ears large; tail very long, bushy and ringed black and white: 4 species, in Mexico and the United States.

*B. astutus* (Lichtenstein). Civet cat; ring-tailed cat. Color uniform blackish gray, often tinged with fulvous on the sides; under parts yellowish gray; length 850 mm.; tail 368 mm.; hind foot 72 mm.: Mexico; Texas to California and northward into Oregon; nocturnal, omnivorous animals, living mostly among rocks; often common.

*Subspecies of B. astutus*

*B. a. flavus* Rhoads. Size smaller; color blackish on the back, tawny on the sides: central and southern Texas to California; Colorado; Utah.

*B. a. oregonus* Rhoads. Dorsal region intensely black; color beneath brownish yellow: western Oregon and northern California.

**3. Nasua** Storr. Body slender; nose prolonged to form a probosis, which projects over the mouth; legs short; tail long: several species in Mexico, 1 over the border.

*N. narica pallida* Allen. Coati. Color pale brown; nose and eye region white; tail faintly ringed with white; fur thick and long; length 1,200 mm.; tail 515 mm.: Mexico; southern Texas and New Mexico.

**Family 4. Mustelidæ.**—Weasels, otters, skunks, etc. Body usually elongate; legs short; feet plantigrade or digitigrade; toes 5-5;

claws never fully retractile; tail usually long; tongue with rasping papillæ; anal glands usually present which secrete a fetid liquid; color usually uniformly dark brown or black and white: numerous species; savage, carnivorous or omnivorous animals found in all the geographical regions except the Australian, and most numerous in the Temperate and Boreal zones, many being valuable fur-bearing animals; about 11 genera and 65 species in North America, 45 species occurring in the United States, grouped in 4 subfamilies.

**Key to the Subfamilies of Mustelidæ**

$a_1$ Toes not webbed or but slightly so.
  $b_1$ Claws partly retractile; weasels, minks, etc.....1. *Mustelinæ.*
  $b_2$ Claws not retractile; claws usually long.
    $c_1$ Last upper molar very large and quadrangular; skunks (Fig. 159).....2. *Mephitinæ.*
    $c_2$ Last upper molar triangular; badgers.....3. *Melinæ.*
$a_2$ Toes completely webbed; otters.....4. *Lutrinæ.*

**Subfamily 1. Mustelinæ.**—Weasels, martens and minks. Body slender; toes short and partly retractile: 3 genera.

**Key to the Genera of Mustelinæ**

$a_1$ Teeth 38, dentition being 3/3, 1/1, 4/4, 1/2 (Fig. 156).
  $b_1$ Feet digitigrade; body slender; martens.....1. *Mustela.*
  $b_2$ Feet plantigrade; body stout; wolverines.....2. *Gulo.*
$a_2$ Teeth 34; body slender and small; weasels (Fig. 158).....3. *Putorius.*

**1. Mustela** L. (*Martes* Pinel). Martens. Body elongate and slender; tail long and bushy; ears short; claws small, sharp and partly retractile: 8 species in North America, about 3 in the United States.

**Key to the United States Species of Mustela**

$a_1$ Body slender.
  $b_1$ Light-colored cheek patches present.....*M. americana.*
  $b_2$ No light-colored cheek patches present.....*M. caurina.*
$a_2$ Body stout.....*M. pennanti.*

*M. americana* Turton. Pine marten; American sable (Fig. 156). Color rich brown, darker middorsally; legs black; tail blackish and bushy; length 610 mm.; tail 205 mm.; hind foot 90 mm.; ears pointed: forests of northern North America from the Atlantic to the Rockies; southward into Pennsylvania; Hudsonian, Canadian and Upper Transition zones; nest in hollow trees or holes in the ground, and up to 8 young annually raised.

*M. caurina* Merriam. Pacific marten. Color rich dark brown; throat orange-buff; length 625 mm.; tail 220 mm.; hind foot 90 mm.: Pacific coast region from northern California to Alaska; central and southern Rockies.

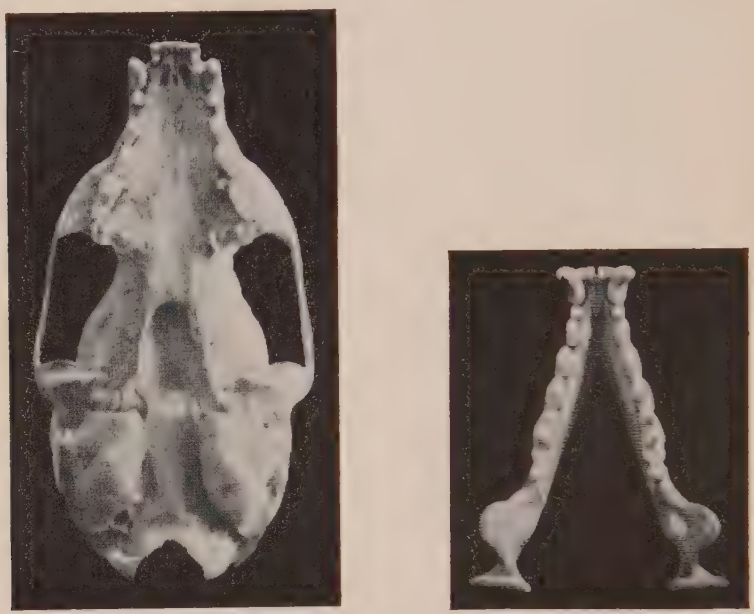


FIG. 156.—Skull of *Mustela americana* (*from Elliot*).

*Subspecies of M. caurina*

*M. c. caurina* Merr. Pacific coast region.

*M. c. origenes* Rhoads. Colors pale: central and southern Rockies.

*M. pennanti* Erxleben. Fisher; pekan. Body relatively stout; color dark brown or blackish, being lighter anteriorly; legs and tip of tail black; length 890 mm.; tail 355 mm.; hind foot 120 mm.: North America from the Atlantic to the Pacific; southward into Maine, New York and the Pennsylvania mountains; usually rare; Hudsonian, Canadian and Transition zones; 1 litter of 1 to 5 young raised.

*Subspecies of M. pennanti*

*M. p. pennanti* Erx. Forests of northern America.

*M. p. pacifica* Rhoads. Size large; length 1,090 mm.: Pacific slope from California to Alaska.

**2. Gulo** Storr. Body stout; tail rather short and bushy; ears very short; feet partly plantigrade; claws compressed: 3 species, 1 in the United States.

*G. luscus* (L.). Wolverine; glutton. Color dark brown or blackish, with a pale band on the sides; face brown; feet large; legs short; fur shaggy; length 900 mm.; tail 200 mm.; hind foot 170 mm.: Boreal forests of North America from Michigan, the Pennsylvania mountains and Colorado to the Arctic, and from the Atlantic to the Pacific; rare or extinct in the eastern States.

**3. Putorius** Cuvier (*Mustela* L.). Weasels and minks. Body elongate and very slender, the two sexes differing very much in size; feet digitigrade; pads of feet separate; dentition 3/3, 1/1, 3/3, 1/2 (Fig. 158); color in summer sharply bicolor (except the mink, which is unicolor), brown above and white beneath, becoming, in many species, pure white in the winter: cosmopolitan; 22 species in North America, 15 in the United States. Weasels are forest animals which feed on all kinds of small mammals and birds, and are noted for their ferocity and blood-thirstiness, which often leads them to kill much more than they can eat. They are essentially terrestrial animals, but can run about in trees with the agility of squirrels. Their dens are in hollow logs or in burrows in sheltered places, and they bear usually about 6 young a year, although sometimes as many as 12.

**Key to the United States Species of Putorius**

$_1$a Length under 500 mm.; toes without webs; weasels.
  b$_1$ In the eastern States.
    c$_1$ From New England to North Carolina ..... *P. noveboracensis.*
    c$_2$ New England, New York and northwards ..... *P. cicognanii.*
    c$_3$ In Maine ..... *P. occisor.*
    c$_4$ In Florida ..... *P. peninsulæ.*
    c$_5$ In western Pennsylvania ..... *P. allegheniensis.*
  b$_2$ In the central plains and the mountains.
    c$_1$ From Minnesota northwards ..... *P. rixosus.*
    c$_2$ From Kansas northwards ..... *P. longicaudus.*
    c$_3$ In the Sierras and Rockies ..... *P. arizonensis.*
    c$_4$ In the Black Hills ..... *P. alleni.*
  b$_3$ On the Pacific slope.
    c$_1$ In California and Oregon ..... *P. xanthogenys.*
    c$_2$ In Oregon and Washington ..... *P. saturatus.*
    c$_3$ In Washington ..... *P. washingtoni.*
    c$_4$ In the Puget Sound region ..... *P. streatori.*
a$_2$ Length greater than 500 mm.
  b$_1$ Color brown; minks ..... *P. vison.*
  b$_2$ Color yellowish; ferrets ..... *P. nigripes.*

*P. noveboracensis* Emmons. Long-tailed weasel; common weasel (Fig. 157). Color in summer brown above and white or yellowish

beneath; posterior third or half of tail black; color in winter white towards the north and drab towards the south, except the end of the tail, which is always black; length 405 mm. (male); tail slender and 140 mm.; hind foot 47 mm.; female about a fifth smaller: eastern and central States; southward into North Carolina; westward to Illinois; Canadian, Transition and Upper Austral zones.

FIG. 157.—Tail of *Putorius noveboracensis* (lower figure) and of *P. cicognanii* (upper figure) (*from Rhoads*).

### *Subspecies of P. noveboracensis*

*P. n. noveboracensis* Em. Eastern States from southern Maine throughout the Transition zone; westward to Illinois.

*P. n. notius* Bangs. Belly yellow; winter coat drab: Austral zones of the eastern States.

*P. cicognanii* (Bonaparte). Short-tailed weasel (Fig. 157). Color in summer brown above and white beneath, except the terminal third of the tail which is black; color in winter white, except the terminal third of the tail which remains black; length 285 mm. (male); tail 77 mm.; hind foot 37 mm.; female about a fifth smaller: Boreal forests of North America from New England, New York and Minnesota northward; westward to Alaska and British Columbia; southward in the Rockies to Colorado.

*P. occisor* Bangs. Similar to *P. noveboracensis;* tail very slender, the black tip very short, confined to the terminal tuft of hair; length (male) 460 mm.; tail 170 mm.; hind foot 50 mm.: southern Maine and northward; rare.

*P. peninsulæ* Rhoads. Color chocolate brown above, yellow beneath; length (female) 375 mm.; tail 127 mm.; hind foot 44 mm.: Florida.

*P. allegheniensis* Rhoads. Color in summer brown above and white beneath and all white in winter; tail without a black tip, but with a few scattered blackish hairs; length 199 mm.; tail 19 mm.; hind foot 20 mm.: western Pennsylvania; rare.

*P. rixosus* Bangs. Least weasel. Similar to *P. allegheniensis;* length 150 mm.; tail 31 mm.; hind foot 22 mm.: Boreal America from Hudson Bay to the Alaska coast; southward into Minnesota and Montana; the smallest carnivorous mammal.

*P. longicaudus* (Bonap.). Long-tailed weasel. Color yellowish brown above and yellowish white beneath; extreme tip of tail black; length (male) 450 mm.; tail 165 mm.; hind foot 51 mm.: central plains from Kansas northwards.

*Subspecies of P. longicaudus*

*P. l. longicaudus* (Bonap.). Great Plains from Kansas northwards.

*P. l. spadix* Bangs. Color dark: Minnesota at lower boundary of the Boreal zone.

*P. arizonensis* Mearns. Similar to *P. longicaudus* but much smaller: Rocky Mountains south of British Columbia; Sierra Nevadas; in the high mountains.

*P. alleni* Merriam. Similar to *P. arizonensis;* upper parts golden brown: Black Hills, South Dakota.

*P. xanthogenys* (Gray). Color umber brown, yellowish beneath; length (male) 402 mm.; tail 156 mm.; hind foot 40 mm.: Pacific slope.

*Subspecies of P. xanthogenys*

*P. x. xanthogenys* (Gray). Southern California.

*P. x. mundus* Bangs. Smaller; colors darker: northern California.

*P. x. oregonensis* Merr. Size large: eastern Oregon.

*P. saturatus* Merr. Similar to *P. longicaudus*, but larger and darker: Oregon and Washington; a mountain form.

*P. washingtoni* Merr. Similar to *P. noveboracensis,* but with a longer tail and a shorter black tip: Mount Adams region, Washington.

*P. streatori* Merr. Similar to *P. cicognanii,* but smaller and darker, the white on the belly being reduced to a narrow, irregular strip: coast region of Washington and Oregon and the high Rockies.

*Subspecies of P. streatori*

*P. s. streatori* Merr. Costal region of Washington and Oregon.

*P. s. leptus* Merr. Size still smaller; black tip of tail very much smaller: Colorado, in the high mountains.

*P. vison* (Scherber). Mink (Fig. 158). Color uniformly dark brown; tail darker and bushy; breast and chin usually spotted white; length 610 mm.; tail 178 mm.; hind foot 63 mm.: forests of North America from the Maine coast to the Gulf of Mexico and the Mexican

boundary; westward to the Rockies and into California, British Columbia and Alaska; along watercourses, where they feed on all kinds of small animals. The nest is in a hollow log or a hole in the ground, and as many as 12 young may form the litter.

FIG. 158.—Skull of *Putorius vison* (*from Elliot*).

### *Subspecies of P. vison*

*P. v. vison* (Scherber). Boreal forests of northern North America; southward to Pennsylvania; Lower Arctic, Hudsonian and Canadian zones.

*P. v. lutreocephalus* (Harlan). Color chestnut brown; length 635 mm.; tail 210 mm.; foot 70 mm.: New England coast to the Gulf of Mexico; westward to the Rockies; Transition and Upper Austral zones.

*P. v. vulgivagus* Bangs. Size small; color light brown: Gulf coast from Texas to Florida.

*P. v. energumenos* Bangs. Size large; color dark: Colorado, westward and northwestward to the Pacific coast.

*P. nigripes* Audubon & Bachman. Black-footed ferret. Color pale yellowish or buff above and beneath, darker middorsally; feet, tip of tail and face black; length (male) 570 mm.; tail 133 mm.; hind foot 60 mm.: Great Plains from western Dakota and Montana to Texas; westward to the base of the Rockies; prairie dogs constitute its principal food.

**Subfamily 2. Mephitinæ.**—Skunks. Body stocky, heavy behind; nose slender; ears small; legs short; claws long and non-retractile; tail usually long and bushy; fur mostly long, loose and silky; color black and white: 3 genera and 30 species, all North American; 20 species in the United States. Skunks are nocturnal animals which live on small mammals, birds eggs, insects, etc., and are found both in forests and open country. Their anal glands secrete a malodorous pungent fluid which is discharged from the rectum and can sometimes be thrown 10 or 15 feet. The northerly species hibernate in the winter. The nest is a hole in the ground, a hollow log or a crevice in the rocks, and as many as 10 young are born in a litter.

**Key to the Genera of Mephitinæ**

$a_1$ Snout not proboscis-like.
  $b_1$ Skull with a convex upper outline; large skunks (Fig. 159) ... 1. *Mephitis.*
  $b_2$ Skull depressed, the upper outline being nearly straight; small skunks ... 2. *Spilogale.*
$a_2$ Snout proboscis-like; on the Mexican border ... 3. *Conepatus.*

**1. Mephitis** Geoffroy & Cuvier. Body stout; claws large and curved; a part of the sole applied to the ground in walking; skull convex; dentition 3/3, 1/1, 3/3, 1/2: about 9 species, all in the United States and Canada, being northerly in distribution.

**Key to the Species of Mephitis**

$a_1$ In the eastern and central States.
  $b_1$ From New England to Virginia and Indiana... *M. putida.*
  $b_2$ In Canada ... *M. mephitis.*
  $b_3$ West Virginia to the Gulf ... *M. elongata.*
$a_2$ In the States west of the Mississippi.
  $b_1$ On the Great Plains from Nebraska northwards. *M. hudsonica.*

b$_2$ From Louisiana and Texas northwards.....*M. mesomelas.*
b$_3$ In New Mexico and Arizona.....*M. estor.*
*M. macroura milleri.*
b$_4$ On the Pacific slope.....*M. occidentalis.*

*M. putida* Boitard. Common skunk (Fig. 159). Color black, with a white stripe on the nose and forehead and a white patch on the back

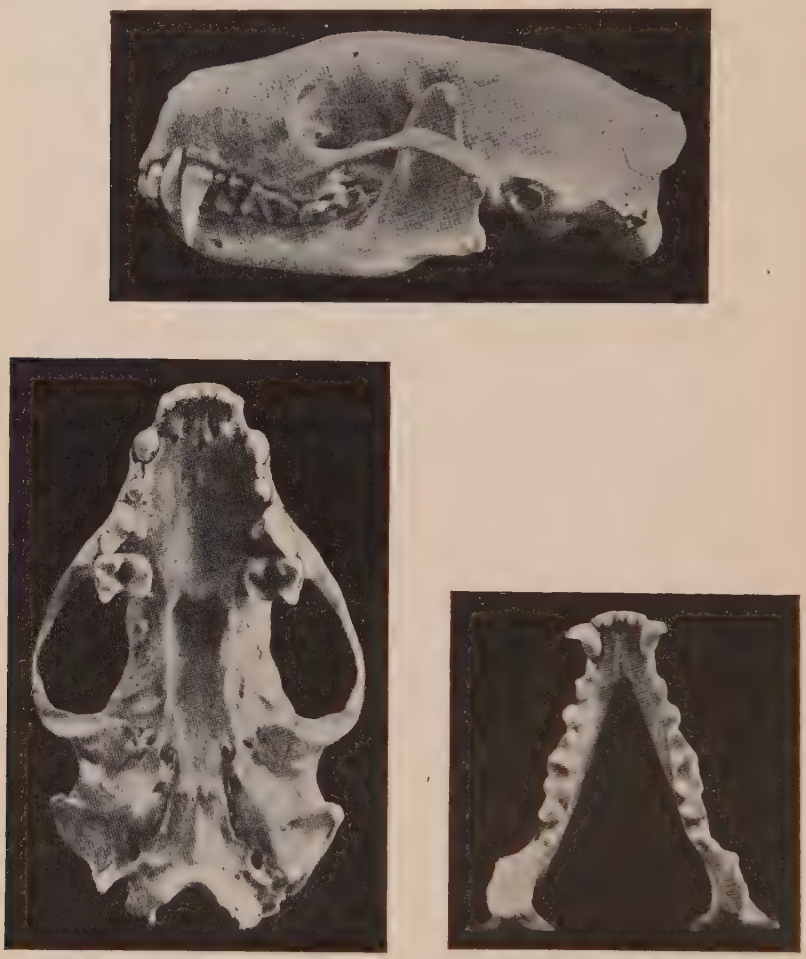


FIG. 159.—Skull of *Mephitis putida* (*from Elliot*).

of the neck, from which a broad white stripe extends backward a varying distance on each side of the body, often to the tail; tip of tail white; length 575 mm.; tail 229 mm.; hind foot 60 mm.: northeastern States; southward to Virginia; westward to Indiana.

*M. mephitis* (Schreber). Color arrangement like *M. putida*, but the white stripes are narrow and extend down the sides of the tail, which is mixed black and white; length 613 mm.; tail 188 mm.; hind foot 78 mm.: Nova Scotia and northern Ontario to Lake Winnipeg.

*M. hudsonica* Richardson. Color similar to *M. mephitis*, but the tip of the tail is black; length 726 mm.; tail 286 mm.; hind foot 82 mm.: Manitoba to eastern British Columbia; southward into Colorado, Nebraska and Minnesota.

*M. elongata* Bangs. Color similar to *M. putida*, but the white stripes are very broad, sometimes entirely covering the back and tail; some specimens almost wholly black; length 703 mm.; tail 317 mm; hind foot 74 mm.: North Carolina to the Gulf; westward along the Gulf coast to the Mississippi.

*M. mesomelas* Lichtenstein. Dorsal white stripes narrow and short, usually extending to the middle of the back, but sometimes to the tail which usually lacks the white tip; length 576 mm.; tail 223 mm.; hind foot 63 mm.: Mississippi Valley from western Indiana into Iowa; southwestward of the river to the Gulf coast of Louisiana and Texas.

*Subspecies of M. mesomelas*

*M. m. mesomelas* Lich. From southern Louisiana to Missouri; westward to Matagorda Island, Texas.

*M. m. varians* Gray. Long-tailed skunk. Length 758 mm.; tail 393 mm.; hind foot 71 mm.: southwestern Texas and eastern New Mexico to Nebraska and Colorado.

*M. m. avia* Bangs. Tail very short; length 641 mm.; tail 184 mm.; hind foot 65 mm.: prairies from Indiana to Iowa.

*M. estor* Merriam. Dorsal stripes very broad, occasionally entirely covering the back and tail; length 639 mm.; tail 285 mm.; foot 69 mm.: Arizona and western New Mexico.

*M. occidentalis* Baird. White stripes varying much in extent, frequently extending on to the tail; length 693 mm.; tail 303 mm.; hind foot 78 mm.: Pacific slope.

*Subspecies of M. occidentalis*

*M. o. occidentalis* Baird. Central California to the Willamette Valley, Oregon.

*M. o. spissigrada* Bangs. White stripes very broad, extending on to the sides of the tail: region of Puget Sound.

*M. o. notata* (Howell). White stripes very narrow, often ending in the middle of the back: northern Oregon and southern Washington, east of the Cascades.

*M. o. major* (Howell). Size large; stripes broad; length 705 mm.: eastern Oregon, and California to Utah.

*M. o. holzneri* Mearns. Size small: southern California.

*M. macroura milleri* Mearns. Back of body and tail nearly all white, although in a considerable proportion of individuals the back is nearly all black; tail very long; length 790 mm.; tail 435 mm.; hind foot 73 mm.: southern Arizona into Mexico.

**2. Spilogale** Gray. Spotted skunks. Body small and slender; skull flattened and with a straight dorsal outline; color pattern in stripes and spots; dentition 3/3, 1/1, 3/3, 1/2: about 13 species, generally southerly in range; 10 species in the United States.

**Key to the United States Species of Spilogale**

$a_1$ In the States east of the Mississippi.
  $b_1$ In the Atlantic and Gulf States, except Florida.....*S. putorius.*
  $b_2$ In Florida.....*S. ambarvalis.*
$a_2$ In the States west of the Mississippi.
  $b_1$ In the central States.
    $c_1$ From Nebraska and Minnesota southwards.....*S. interrupta.*
    $c_2$ In the coast region of Louisiana and Texas.....*S. indianola.*
    $c_3$ On the eastern slopes of the Rockies.....*S. tenuis.*
  $b_2$ In the southwestern States.
    $c_1$ From western Texas to central Arizona.....*S. leucoparia.*
    $c_2$ In the Great Basin from northern Arizona to Idaho.....*S. gracilis.*
    $c_3$ From central Arizona southwards.....*S. ambigua.*
      *S. arizonæ.*
  $b_3$ On the Pacific slope.....*S. phenax.*

*S. putorius* (L.). Color black, with 4 white narrow longitudinal stripes on the forward half of the body and 2 transverse stripes on the hinder half; end of tail white; length 516 mm.; tail 206 mm.; hind foot 48 mm.: south Atlantic and Gulf States from western Virginia to western Georgia, and westward into Mississippi.

*S. ambarvalis* Bangs. Size small; tail short; color like *S. putorius;* length 386 mm.; tail 120 mm.; hind foot 40 mm.: eastern Florida.

*S. interrupta* (Rafinesque). White stripes much reduced, sometimes represented by a few spots; tail wholly black: southern Minnesota and Nebraska to central Texas.

*S. indianola* Merriam. Color similar to *S. interrupta*, but the tail has a white tip; length 472 mm.; tail 183 mm.; hind foot 48 mm.: Gulf coast of Louisiana and Texas.

*S. tenuis* Howell. White markings very broad; length 450 mm.; tail 165 mm.; hind foot·51 mm.: eastern slopes of the Rockies in New Mexico and Colorado.

*S. leucoparia* Merr. White markings very broad; no white of legs: western Texas to central Arizona.

*S. gracilis* Merr. Like *S. leucoparia;* length 381 mm.; tail 143 mm.; hind foot 44 mm.: Great Basin from Arizona and California into Oregon and Idaho.

*S. ambigua* Mearns. Like *S. gracilis:* central Arizona, southward.

*S. arizonæ* Mearns. Like *S. gracilis,* but larger: central New Mexico and Arizona, southward.

*S. phenax* Merr. Dorsal pair of white stripes narrow, lateral pair much broader; length 470 mm.; tail 154 mm.; hind foot 52 mm.: Pacific slope.

*Subspecies of S. phenax*

*S. p. phenax* Merr. California, except the southeastern and the northern portions.

*S. p. latifrons* Merr. White stripes less prominent: Oregon coast region.

*S. p. olympica* Merr. Tail shorter: Olympic peninsula.

**3. Conepatus** Gray. Snout long and proboscis-like, with a large bare pad on the upper side for rooting; color black, with a white tail and a wide middorsal white band; dentition 3/3, 1/1, 2/3, 1/2: 7 species in Mexico and Central and South America.

*C. mesoleucus telmalestes* Bailey. Hog-nose skunk. Length 670 mm.; tail 290 mm.; hind foot 75 mm.: central and southern Texas to Arizona.

**Subfamily 3. Melinæ.**—Badgers. Body stocky; legs short; toes not retractile, with long claws; tail very short: 1 genus.

**Taxidea** Storr. Dentition 3/3, 1/1, 3/3, 1/2; skull attenuate in front: 1 species.

*T. taxus* (Schreber). American Badger. Color gray, mottled with black dorsally and with a white stripe running from the top of the nose to the shoulder; belly whitish; length 675 mm.; tail 125 mm.; weight about 15 lbs.: western North America from western Texas and Mexico to Hudson Bay and Lake Athabaska; eastward into Wisconsin, Michigan and Kansas; westward to the Pacific coast. The badger lives in deep burrows in the ground and feeds on small animals of all kinds, especially rodents. Towards the north they hibernate in the winter; a single litter of from 2 to 5 young is raised annually.

*Subspecies of T. taxus*

*T. t. taxus* (Schreber). Western America.

*T. t. berlandieri* Baird. A white middorsal stripe from nose to tail: western Texas and westward.

*T. t. neglecta* Mearns. Size smaller: California.

**Subfamily 4. Lutrinæ.**—Otters. Body mostly elongate; legs short; head broad behind, with a sharp snout; ears small and round; toes webbed; tail long, broad and flattened; fur short and dense: 2 genera.

**Key to the Genera of Lutrinæ**

$a_1$ Body elongate; river otters.....1. *Lutra.*
$a_2$ Body rather stout; sea otters.....2. *Latax.*

**1. Lutra** Brisson. With the characters of the subfamily; dentition 3/3, 1/1, 4/3, 1/2: many species, cosmopolitan; 1 species in the United States.

*L. canadensis* (Schreber). American otter. Color seal brown, grayish beneath; under surface of webs of toes densely hairy; length 1,100 mm.; tail 420 mm.; hind foot 120 mm.: North America from the Atlantic to the Pacific; northward to the tree line; aquatic animals, living along streams and lakes and eating fish. The animal's den is in the side of the bank with its opening often below the water; the number of young annually raised is from 1 to 5.

*Subspecies of L. canadensis*

*L. c. canadensis* (Schreber). Eastern North America north of North Carolina.

*L. c. lataxina* F. Cuvier. Upper surface yellowish brown: southeastern and Gulf States from North Carolina to Mississippi.

*L. c. vaga* Bangs. Darker and redder: Gulf coast from Florida to Louisiana.

*L. c. pacifica* Rhoads. Size large; color lighter: Pacific slope from California to Alaska.

*L. c. sonora* Rhoads. Size very large; length 1,300 mm.: Wyoming to Arizona and Mexico.

*L. degener* Bangs. Color blackish; length 995 mm.: Newfoundland.

**2. Latax** Gloger. Sea otters. Body elongate but stout; tail rather short; hind feet short and very large; dentition 3/2, 1/1, 3/3, 1/2: 1 species.

*L. lutris* (L.). Sea-otter. Color deep glossy brownish black; length 1,500 mm.; tail 300; muzzle beset with bristles: shores of the Pacific

from Lower California to Alaska; the most valuable American fur animal. The sea otter feeds principally on shell-fish and sea-urchins; but one young is born.

**Family 5. Felidæ.**—Cats. Body more or less elongate, compact and lithe; feet digitigrade; toes 5-4; claws compressed, sharp and retractile; head short and round; tongue with rasping papillæ; pupil elliptical: cosmopolitan (except in Australia); many species, which are most numerous in the tropics and subtropics; about 29 species in North America and 16 in the United States and Canada, grouped in 2 genera.

**Key to the United States Genera of Felidæ**

$a_1$ Tail long.....1. *Felis.*
$a_2$ Tail short.....2. *Lynx.*

**1. Felis** L. Cats. Body slender; fur soft and compact; dentition 3/3, 1/1, 3/2, 1/1: about 50 species; 9 species and subspecies in the United States. Of these species about 6 are different geographical races of pumas, which are the only native cats ranging over the whole country, while the other 3 species are Central American cats which occur along the Mexican border. The pumas are characterized among cats by the following features; large size, slender build, a small head, a long tail and absence of color markings. They are confined to America, ranging from southern Patagonia to southern British America. The domestic cat, *F. domestica*, is a descendant of the Egyptian wild cat, *F. maniculata*, but with a considerable admixture of the European wild cat, *F. catus*. The yellow tabby cat is probably the result of such a cross. The domestic cat usually bears from 3 to 6 at a birth. The puma bears from 2 to 5 young, which are often spotted and have ringed tails.

**Key to the United States Species of Felis**

$a_1$ Color uniform, without spots or stripes.
  $b_1$ Size large; legs long; pumas.
    $c_1$ In the northeastern States.....*F. couguar.*
    $c_2$ In Florida.....*F. coryi.*
    $c_3$ In Louisiana.....*F. arundivaga.*
    $c_4$ In the Far-west.....*F. oregonensis.*
  $b_2$ Size smaller; legs short.....*F. cacomitli.*
$a_2$ Color not uniform; body spotted or striped.
  $b_1$ Size large; body spotted and without stripes; jaguar.....*F. hernandesi.*
  $b_2$ Size smaller; body with both spots and stripes.....*F. pardalis.*

*F. couguar* Kerr. Puma; cougar; mountain lion; panther; painter; catamount. Color uniform yellowish brown or fulvous, darker middorsally; under parts reddish or whitish; tail tipped with black or brown; length 2,600 mm.; tail 930 mm.; hind foot 270 mm.: eastern and central America; northward into southern Canada; extinct in all well settled regions, but may still exist in the Adirondacks and the higher Alleghanies.

*F. coryi* Bangs. Florida cougar. Size larger than that of *F. couguar;* head large and massive; feet small; color of back very dark: central Florida.

*F. arundivaga* Hollister. Size large; color grayish fawn above; tail darker, with a dark brown median line; throat and breast white; face blackish, with a white streak over each eye: cane-brakes of Louisiana.

*F. oregonensis* Rafinesque. Western puma; mountain lion. Size large; color dull fulvous; head large and massive: Rocky Mountain and Pacific coast regions.

*Subspecies of F. oregonensis*

*F. o. oregonensis* Raf. Largest of the pumas; color very dark; belly whitish: coastal region from California to British Columbia.

*F. o. hippolestes* Merriam. Not so large as *F. o. oregonensis;* head with a high median crest: Rocky Mountains and Great Basin.

*F. o. azteca* Merr. Size moderate; color dull fulvous; tail much darker and with a longer black tip; no white underneath; ears black: lower Colorado River Valley and Mexico.

*F. cacomitli* Baird. Jaguarundi cat; eyra. Color uniformly either gray or rusty rufous, there being 2 distinct color phases; length 1,060 mm.; tail 480 mm.; hind foot 140 mm.: South and Central America; southern Texas.

*F. pardalis* L. Ocelot; tiger cat. Color tawny or brown, with large blackish spots and stripes, each one enclosing a lighter one; length 970 mm.; tail 347 mm.: southern Louisiana and Texas to Patagonia.

*F. hernandesi* (Gray). Jaguar. Color tawny yellow, spotted with black rings; length 2,100 mm.; tail 600 mm.: southern United States to Patagonia; formerly numerous, still found from central Texas to northern Arizona.; number of young at a birth 2.

**2. Lynx.** Kerr. Body short and thick; tail short; legs long; dentition 3/3, 1/1, 2/2, 1/1; ears with a tuft of long hairs at the tip: many species, all in the northern hemisphere, about 6 in North America; woodland animals, preying largely on rodents; number of young, 2 to 5.

**Key to the United States Species of Lynx**

$a_1$ Feet moderate in size; tail moderately short; skull narrow; fur short and dense.
  $b_1$ In the eastern States.
    $c_1$ Color dull, with little black on upper parts.....*L. ruffus.*
    $c_2$ Color rich, with much black on upper parts; size large; in Nova Scotia.....*L. gigas.*
  $b_2$ In the Rocky Mountain States.....*L. uinta.*
    *L. baileyi.*
  $b_3$ On the Pacific slope.....*L. fasciatus.*
$a_2$ Feet very large; tail very short; fur long and loose; skull broad.
  $b_1$ Color gray.....*L. canadensis.*
  $b_2$ Color very dark; in Newfoundland.....*L. subsolanus.*

*L. ruffus* (Güldenstädt). Wildcat; bobcat. Color reddish brown in winter and ash brown in summer, spotted and streaked with black; tail ringed with black; length 900 mm.; tail 170 mm.; hind foot 180 mm.; weight up to 20 lbs.: Nova Scotia to the Gulf of Mexico and into Mexico, and from the Atlantic to the Pacific; in wooded regions.

*Subspecies of L. ruffus*

*L. r. ruffus* (Güld). Eastern States; southward into Georgia.

*L. r. floridanus* Rafinesque. Color darker: Florida and Georgia.

*L. r. texensis* Allen. Belly and inner surface of legs white, with brown spots: southern Texas.

*L. r. californicus* Mearns. Size large; color dark: coast region of southern California.

*L. r. eremicus* Mearns. Color pale: deserts of the Mexican border; southern California.

*L. uinta* Merriam. Mountain wildcat. Color buff, grizzled with gray and black, with black spots; white beneath; tail with 2 or 3 black bands: southern Wyoming; Colorado.

*L. gigas* Bangs. Color cinnamon rufus above, much spotted and streaked with black; length 1,000 mm.; tail 180 mm.; hind foot 200 mm.: Nova Scotia.

*L. fasciatus* Raf. Pacific wildcat. Color chestnut brown above, pale on the sides and white, spotted with black beneath; terminal third of tail black; length 890 mm.; tail 139 mm.: Washington to California.

*Subspecies of L. fasciatus*

*L. f. fasciatus* Raf. Washington and Oregon.

*L. f. pallescens* Merr. Color hoary gray: northern California and northward.

*L. f. oculeus* Bangs. Back darker, without stripes or spots; sides gray; tip of tail white; length 770 mm.; tail 139 mm.; hind foot 158 mm.: coast region of California north of San Francisco.

*L. baileyi* Merr. Plateau wildcat. Similar to *L. ruffus*, but paler and with a shorter tail: Arizona; southern Colorado.

*L. canadensis* Kerr. Canada lynx. Color gray, mottled with brown; tail-tip black; length 1,000 mm.; tail 100 mm.; hind foot 225 mm.; weight up to 30 lbs.; legs thick; fore feet very large: northern America, in forested regions from Pennsylvania and northern Michigan to Hudson Bay and Alaska; southward in the Rockies as far as Colorado, and in the Sierras as far as Mount Whitney; extinct in the eastern States.

*L. subsolanus* Bangs. Color black and hazel, much darker than *L. canadensis;* length 920 mm.; tail 110 mm.; hind foot 220 mm.: Newfoundland.

**Order 7. Pinnipedia.**—Seals. Aquatic mammals of large size and carnivorous habits, and closely related to the Order *Carnivora;* feet transformed to flippers; toes 5-5, joined by a thick membrane; hinder limbs directed backwards and used for swimming; no external ears usually present: about 50 species, in temperate and Arctic seas; in Lake Baikal (fresh water); about 11 species on the coasts of the United States and Canada, grouped in 2 families.

**Key to the Families of Pinnipedia**

$a_1$ External ears present.....1. *Otariidæ.*
$a_2$ External ears absent.....2. *Phocidæ.*

**Family 1. Otariidæ.**—Hind limbs capable of being turned forward and used for walking; ears present; forelegs long; claws small and rudimentary, except those on digit 3 of the foot: 3 genera and species on the Pacific coast.

1. **Zalophus** Gill. Ears short; dentition 3/2, 1/1, 4/4, 2/1; head rounded; nose narrow, pointed: 1 species.

*Z. californicus* (Lesson). Sea-lion. Color reddish brown in summer, lighter in winter; length 2,542 mm.; tail 110 mm.; hind foot 380 mm.; body slender; snout long: California, northward to San Francisco.

2. **Eumetopias** Gill. Ears rather long; dentition 3/2, 1/1, 4/4, 1/1; upper molar separated by a wide space from the premolars: 1 species.

*E. jubata* (Schreber). Steller's sea-lion. Color reddish brown; length 3,000 mm.: Berings Strait to California.

**3. Callorhinus** Gray. Dentition 3/2, 1/1, 4/4, 2/1; facial portion of skull short: 1 species.

*C. alascanus* Jordan & Clark. Fur seal. Color chestnut brown; length 1,887 mm.; tail 51 mm.; hind foot 548 mm.: Berings Strait to California. The animals breed on the Pribilof Islands in June, spending the summer and fall there; in the winter and spring they migrate southward, ranging as far south as southern California.

**Family 2. Phocidæ.** Hind limbs directed permanently backwards, and of no use in walking; ears absent; fore legs short; claws well developed: about 5 species on the American coasts.

**Key to the American Genera of Phocidæ**

$a_1$ Teeth 34.
  $b_1$ Molars with 2 to 4 cusps each.....1. *Phoca.*
  $b_2$ Molars with 1 cusp each.....2. *Halichærus.*
$a_2$ Teeth 30; snout proboscis-like.....3 *Cystophora.*

**1. Phoca** L. Snout narrow and pointed; dentition 3/2, 1/1, 4/4, 1/1; forehead convex; incisors conical: cosmopolitan.

*P. vitulina* L. Harbor seal. Color yellowish gray, spotted with black; length 1,500 mm.: circumpolar; southward to Lower California and New Jersey; common on the New England coast; ascending rivers; occasionally in Lake Champlain and Lake Ontario.

*P. hispida* Schreber. Ringed seal. Color blackish above, with large whitish spots; length 1,500 mm.; body slender; limbs long: circumpolar; southward to Newfoundland.

*P. grœnlandica* Erxleben. Harp seal. Color gray, with a black face and a black band across the shoulder and extending along the sides; length 1,500 mm.; body slender; weight 600 to 800 lbs.; circumpolar; southward to Newfoundland and the Magdalen Islands; the basis of the sealing industry in Newfoundland.

**2. Halichærus** Nilsson. Snout broad and short; teeth 34; molars conical, with a single cusp; incisors conical; claws well developed: 1 species.

*H. grypus* (Fabricius). Gray seal. Color gray, with dark irregular dark spots; length 2,500 mm.; flippers hairy only along the toes: North Atlantic; southward to Nova Scotia.

**3. Cystophora** Nilsson. Snout elongated, forming a short proboscis and capable of inflation in the male; dentition 2/1, 1/1, 4/4, 1/1; incisors conical; molars and premolars small and separated from one another: 1 species.

*C. cristata* (Erxleben). Hooded seal. Color bluish black, with whitish spots; length 2,800 mm.: North Atlantic; southward occasionally to Long Island.

**Order 8. Rodentia.**—Rodents. Small or medium-sized mammals with long chisel-like incisor teeth, no canines, and grinders (premolars and molars) which are separated from the incisors by a wide space, the incisors having persistent papillæ and growing continuously (Fig. 168); feet mostly pentadactylous and plantigrade; placenta discoidal: about 1,400 species grouped in about 21 families, constituting a third of all mammals and occurring on all the continents; about 400 species in the United States.

**Key to the United States Families of Rodentia**

$a_1$ Tail present.
  $b_1$ Two upper incisors present.
    $c_1$ Tail cylindrical or compressed laterally (except flying-squirrels).
      $d_1$ No quills in the fur.
        $e_1$ Body stout; fore feet with digging claws; pocket gophers ..... 2. *Geomyidæ.*
        $e_2$ Fore feet not with digging claws.
          $f_1$ Not more than 3 well-developed grinders in each jaw.
            $g_1$ No cheek-pouches present.
              $h_1$ Hind legs not greatly elongated; rats and mice ..... 1. *Muridæ.*
              $h_2$ Hind legs greatly elongated; jumping mice ..... 4. *Zapodidæ.*
            $g_2$ Large cheek-pouches present; pocket mice. 3. *Heteromyidæ.*
          $f_2$ At least 4 well developed grinders in each jaw.
            $g_1$ Tail very short; mountain beavers ..... 6. *Aplodontiidæ.*
            $g_2$ Tail long or moderate; squirrels; marmots 7. *Sciuridæ.*
      $d_2$ Long quills present in the fur; porcupines ..... 5. *Erethizontidæ.*
    $c_2$ Tail large and flattened; beavers ..... 8. *Castoridæ.*
  $d_2$ Four upper incisors present; rabbits and hares ..... 9. *Leporidæ.*
$a_2$ External tail wanting; pikas ..... 10. *Ochotonidæ.*

**Family 1. Muridæ.**—Rats and mice. Small, slender rodents with a long tail, with feet not specially modified and with naked soles; snout elongated; nostrils separated by a furrow; eyes and ears large; upper lip usually divided; dentition 1/1, 0/0, 0/0, 3/3: over 700 species and 100 genera, comprising half of all rodents and being the largest family of mammals; distribution cosmopolitan; 150 species in the United States, grouped in 4 subfamilies.

### Key to the Subfamilies of Muridæ

a1 Molars with a more or less tuberculate biting surface (Fig. 160).
  b1 Tubercles arranged in 3 longitudinal rows.....1. *Murinæ.*
  b2 Tubercles arranged in 2 rows (Fig. 160).....2. *Cricetinæ.*
a2 Molars with a flattened surface and not tuberculate (Fig. 167).
  b1 Tail long; body slender.....3. *Neotominæ.*
  b2 Tail short; body stout.....4. *Microtinæ.*

**Subfamily 1. Murinæ.**—Old world rats and mice. Form slender; tail long and scaly and scantily haired; thumb rudimentary: 130 species, in all parts of the old world except Madagascar; a few species have followed man to the new world.

**Mus** L. With the characters of the subfamily: 4 semidomesticated species in the United States.

*M. musculus* L. House-mouse. Body brownish gray in color; length 170 mm.; tail 85 mm.; hind foot 17 mm.: everywhere in houses; often in fields and woods; about 5 litters annually of 4 to 9 each.

*M. norvegicus* Erxleben. (*M. decumanus* Pallas.) Common rat; brown rat. Body brown above and gray beneath; length 400 mm.; tail 180 mm.; hind foot 45 mm.: very common. This rat made its appearance in Europe in eastern Russia in 1727, and rapidly spread westward, driving out and replacing the black rat, which up to that time had been the common house-rat. It appeared in America about the time of the Revolutionary War.

*M. rattus* L. Black rat. Body glossy black in color; length 400 mm.; tail 215 mm.; hind foot 37 mm.: during colonial times the common house-rat in America, but now almost exterminated by the larger, fiercer brown rat.

*M. alexandrinus* Geoffroy. Roof-rat. Body brown above, white beneath; length 390 mm.; tail 200 mm.; hind foot 35 mm.: southern United States; common in some places.

**Subfamily 2. Cricetinæ.**—American rats and mice. Body slender; ears and eyes large; legs and tail long; tail well haired; upper molars usually with tubercles arranged in 2 longitudinal rows (Fig. 160): about 50 species in the United States.

### Key to the Genera of Cricetinæ

a1 Tubercles on surface of upper molars in 2 distinct longitudinal rows (Fig. 160).
  b1 Upper incisors longitudinally grooved (Fig. 161).....2. *Reithrodontomys.*
  b2 Upper incisors not thus grooved.
    c1 Soles of feet with 4 plantar tubercles.....1. *Onychomys.*
    c2 Soles of feet with 5 or 6 plantar tubercles (Fig. 163).

$d_1$ Belly pure white; fur fine.....3. *Peromyscus.*
$d_2$ Belly not pure white; fur coarse.....4. *Oryzomys.*
$a_2$ Tubercles of molars form flattened S-shaped loops .....5. *Sigmodon.*

1. **Onychomys** Baird. Grasshopper mice; scorpion mice. Body stout; fur dense and velvety; tail short; fore feet strong; ears hairy: 2 species, in western America; nocturnal burrowing animals which

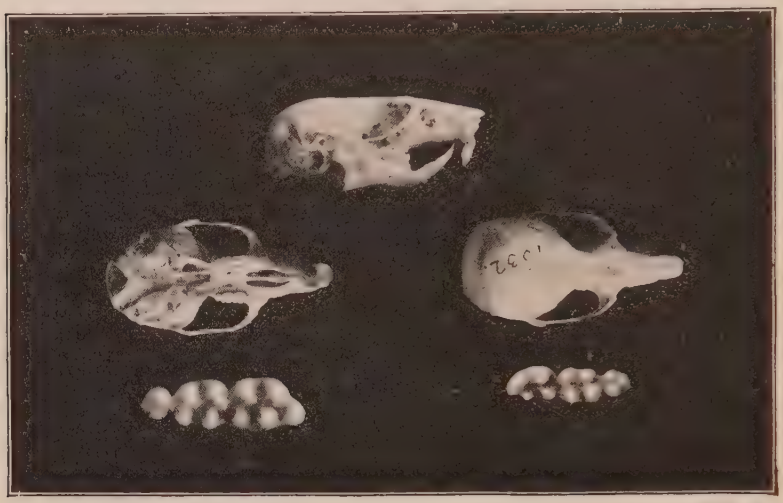


FIG. 160.—Skull and tuberculate molars of *Onychomys leucogaster* (*from Elliot*).

feed largely on insects, scorpions and other small animals; several litters of from 2 to 6 young each raised each year; the animals do not hibernate.

**Key to the Species of Onychomys**

$a_1$ Tail usually less than half the length of the head and trunk.....*O. leucogaster.*
$a_2$ Tail usually more than half the length of the head and trunk....*O. torridus.*

*O. leucogaster* (Weid) (Fig. 160). Body light mouse-brown above, being darker middorsally, and snow-white beneath; length 150 mm.; tail 40 mm.; hind foot 20 mm.: western America, from eastern Dakota and Kansas to eastern California; Mexico.

*Subspecies of O. leucogaster.*

*O. l. leucogaster* (Wied). Size large; length 164 mm.; color dark: eastern and central North Dakota.

*O. l. missouriensis* (Audubon & Bachman). Size large; color pale: western North Dakota and Montana.

*O. l. articeps* Rhoads. Like *O. l. missouriensis*, but still paler, buff in color: Wyoming and South Dakota; southward to southwestern Texas.

*O. l. brevicaudus* Merriam. Size small; length 141 mm.; color darker than *O. l. articeps:* southern Idaho, northern Utah and Nevada.

*O. l. fuscogriseus* Merr. Color darker; size small: eastern and central Washington and Oregon.

*O. l. melanophrys* Merr. Color dark, being pinkish-cinnamon: southern Utah and Colorado and northern New Mexico and Arizona.

*O. l. ruidosæ* Stone & Rehn. Color dark: southern New Mexico and southeastern Arizona.

*O. l. longipes* Merr. Size large; length 190 mm.; tail 48 mm.; hind foot 25 mm.; color dull: central and southern Texas.

*O. l. breviauritus* Hollister. Like *O. l. longipes*, but darker and with a shorter tail and hind foot: eastern Nebraska and central Kansas and Oklahoma.

*O. torridus* (Coues). Body fulvous brown above and white beneath; length 150 mm.; tail 50 mm.; hind foot 20 mm.: southwestern United States; Mexico.

*Subspecies of O. torridus*

*O. t. torridus* (Coues). Southwestern Texas, southern New Mexico, southeastern Arizona and northern Mexico.

*O. t. perpallidus* Mearns. Size larger: western Arizona.

*O. t. pulcher* Elliot. Size small; length 136 mm.; color very pale: deserts of southern California.

*O. t. longicaudus* Merriam. Size large; color pale: southwestern Utah; northwestern Arizona, Nevada and Inyo and Mono counties, California.

*O. t. tularensis* Merr. Color grayish drab above: upper San Joaquin Valley, California.

*O. t. ramona* Rhoads. Color very dark: southwestern California.

FIG. 161.—Incisor teeth of *Reithrodontomys megalotis* (*from Mearns*).

**2. Reithrodontomys** Giglioli. American harvest mice. Body small and slender; tail long, being a third or a half the body length; ears prominent; anterior face of upper incisor with a deep longitudinal groove (Fig. 161); sole of hind foot with 6 plantar tubercles: 50 species, in tropical and subtropical America; 6 species in the United States; mainly nocturnal animals which live in open, grassy places, often near water, and feed upon grains, fruits and vegetables. Most species build a globular nest of grass often

elevated above the ground in weeds or bushes and, raise from 3 to 7 young in a litter and several litters a year. They resemble the house-mouse in appearance, but may be distinguished by the browner colors, more hairy tail and grooved upper incisors.

**Key to the Species of Reithrodontomys**

$a_1$ Tail less than 65 mm. long.
  $b_1$ Upper parts blackish or dark brown.....*R. humulis.*
  $b_2$ Upper parts grayish or buff, mixed with black, with a distinct dorsal stripe.....*R. albescens.*
$a_2$ Tail more than 65 mm. long.
  $b_1$ Ears light brown or drab.
    $c_1$ In the western and Pacific States.....*R. megalotis.*
    $c_2$ On Catalina Island.....*R. catalinæ.*
    $c_3$ In Texas, Louisiana and northwards.....*R. fulvescens.*
  $b_2$ Ears blackish brown; in western California.....*R. raviventris*

*R. humulis* (Audubon & Bachman) (Fig. 162). Eastern harvest mouse. Color dark brown above mixed with pinkish cinnamon, darker on the head and middorsally; whitish beneath; length 120 mm.; tail 57 mm.; hind foot 16 mm.: southern States.

FIG. 162.—*Reithrodontomys humulis (after Stone & Cram).*

*R. h. humulis* (Aud. & Bach.). Ear 9 to 10 mm. long: coastal plain from Virginia to central Florida.

*R. h. impiger* Bangs. Ears smaller: mountains of northern Virginia and West Virginia.

*R. h. merriami* Allen. Ears smaller; under parts darker: central Kentucky to central Alabama and westward to the east Texas coast.

*R. albescens* Cary. Color very pale; length 125 mm.: South Dakota to central Texas.

*R. megalotis* (Baird) (Fig. 161). Western harvest mouse. Color brownish buff on the back and buff on the sides; white beneath and on the feet; length 140 mm.; tail 71 mm.; hind foot 17 mm.; ear 12 mm.: western States to the Pacific; southward into Mexico.

*Subspecies of R. megalotis*

*R. m. megalotis* (Baird). Southern Idaho southward to eastern California and the Mexican border; then eastward to southwestern Texas.

*R. m. aztecus* Allen. Ears and skull larger: northern New Mexico, northeastern Arizona, southeastern Utah and western Colorado.

*R. m. dychei* Allen. More black on the upper parts; tail shorter: eastern Iowa and Missouri to central Colorado and Wyoming; northward to North Dakota.

*R. m. nigrescens* Howell. Under parts more blackish: eastern Washington, Oregon and northern California and western Idaho.

*R. m. longicaudus* (Baird). Colors darker; length 152 mm.; tail 75 mm.; hind foot 17 mm.: western California, west of the Sierras.

*R. catalinæ* Elliot. Similar to *R. m. longicaudus*, but larger; length 169 mm.; tail 94 mm.: Santa Catalina Island.

*R. raviventris* Dixon. Upper parts very dark; under parts pinkish; length 130 mm.; tail 64 mm.; hind foot 16 mm.: salt marshes of San Francisco Bay.

*Subspecies of R. raviventris*

*R. r. raviventris* Dix. Southern part of San Francisco Bay.

*R. r. halicœtes* Dix. Size larger; length 156 mm.; under parts white: salt marshes of San Pablo, Suisan Bay and the lower San Joaquin and Sacramento Rivers.

*R. fulvescens* Allen. Color buff above, white beneath; length 183 mm.; tail 102 mm.; hind foot 19 mm.: Mexico and southern States.

*Subspecies of R. fulvescens*

*R. f. intermedius* Allen. Color pale: southern Texas.

*R. f. aurantius* Allen. Color darker: eastern Texas and Oklahoma, southern Arkansas and Louisiana west of the Mississippi.

Fig. 163.—Hind foot of *Peromyscus leucopus*, showing the plantar tubercles (*from Howell*).

**3. Peromyscus** Gloger. Wood mice; deer mice; vesper mice; white-footed mice. Body small and slender; tail long, being a third or a half the total length; eyes and ears large; internal cheek pouches present; hind feet and legs long, the former with 6 plantar tubercles (Fig. 163): about 100 species, all North American; about 15 species in the United States, with many subspecies; nocturnal animals which live on the ground in a great variety of situations, feeding principally on grains and seeds. They do not form permanent runways, although they may use those of other animals. They breed throughout the year, raising from 4 to 6 in a litter, and do not hibernate, and may exceed in

numbers all the other mammals in a region. They frequently enter and live in dwellings, and may be distinguished from the house-mouse by their snow-white feet and under parts.

### Key to the United States Species of Peromyscus

$a_1$ Length over 120 mm.
  $b_1$ Mammæ 6.
    $c_1$ Plantar tubercles 6 (Fig. 163).
      $d_1$ Ears dusky or dusky edged with white.
        $e_1$ Hind foot less than 25 mm. long.
          $f_1$ Tail shorter than head and trunk.
            $g_1$ Size very small; length 120-130 mm.
              $h_1$ In Florida and Georgia.....*P. polionotus.*
              $h_2$ In Texas.....*P. maniculatus pallescens.*
            $g_2$ Length over 130 mm.
              $h_1$ Tail very sharply bicolor....*P. maniculatus.*
              $h_2$ Tail not sharply bicolor.
                $i_1$ In the southern States.....*P. gossypinus.*
                $i_2$ In the central and eastern States.....*P. leucopus.*
          $f_2$ Tail equal to or longer than head and trunk.
            $g_1$ Ears large, being 18-25 mm. from notch.....*P. truei.*
            $g_2$ Ears 18 or less from notch.
              $h_1$ Hind foot 23 mm. or more long.
                $i_1$ Tail usually less than 90 mm. long.
                  $j_1$ In the southern States.*P. gossypinus.*
                  $j_2$ Eastern and central States.....*P. leucopus.*
                $i_2$ Tail more than 90 mm. long.*P. boylei.*
              $h_2$ Hind foot under 23 mm. long.
                $i_1$ Tail about the length of head and trunk.
                  $j_1$ Tail sharply bicolor....*P. maniculatus*
                  $j_2$ Tail not sharply bicolor.
                    $k_1$ In the southern States.....*P. gossypinus.*
                    $k_2$ Eastern and central States.....*P. leucopus.*
                $i_2$ Tail longer than head and trunk.
                  $j_1$ Tarsal joints white....*P. pectoralis.*
                  $j_2$ Tarsal joints dusky.
                    $k_1$ Proximal half of foot hairy.....*P. maniculatus.*

$k_2$ Proximal fourth of foot hairy.....*P. boylei.*
$e_2$ Hind foot 25 mm. or more long.
$f_1$ Tail under 90 mm. long.....*P. gossypinus.*
$f_2$ Tail over 90 mm. long.....*P. boylei.*
$d_2$ Ears ochraceous, like the body.....*P. nuttalli.*
$c_2$ Plantar tubercles 5.....*P. floridanus.*
$b_2$ Mammæ 4.
$c_1$ Hind foot 19-24 mm. long.
$d_1$ In the Great Basin.....*P. crinitus.*
$d_2$ Along the Mexican border.....*P. eremicus.*
$c_2$ Hind foot 25-29 mm. long.....*P. californicus.*
$a_2$ Length about 100 mm.....*P. taylori.*

*P. maniculatus* (Wagner). Color brown or brownish gray above, the middorsal region being darker; under parts and feet white; length 160 to 200 mm.; tail 70 to 98 mm.; hind foot 19 to 21 mm.; tail and body sharply bicolor: North America from Hudson Bay and Alaska to southern Mexico, which is the widest range of perhaps any North American mammal; mostly in woodlands.

*Subspecies of P. maniculatus*

*P. m. maniculatus* (Wag.). Tail short, averaging less than 90 mm. in length: Hudsonian zone of northeastern Canada.

*P. m. gracilis* (LeConte). Tail very long; length 190 mm.; tail 96 mm.: northern and central New York, northern Michigan, Wisconsin and Minnesota; Canadian zone.

*P. m. abietorum* Bangs. Similar to *P. m. gracilis* but paler and grayer: northeastern Maine to Nova Scotia.

*P. m. nubiterræ* Rhoads. Like *P. m. gracilis*, but smaller: Alleghenies from western Pennsylvania to Georgia.

*P. m. oreas* Bangs. Size large; color very dark; length 203 mm.; tail 111 mm.; hind foot 23 mm.: western Washington from the Columbia River into British Columbia.

*P. m. artemisia* (Rhoads). Color brownish fawn: northwestern Wyoming to western Washington and British Columbia.

*P. m. austerus* (Baird). Color very dark: coast region of Puget Sound.

*P. m. rubidus* Osgood. Like *P. m. oreas*, but paler and tail and hind foot shorter: coast region from San Francisco Bay to the Columbia.

*P. m. gambeli* (Baird). Like *P. m. rubidus*, but smaller and paler: central Washington to Lower California; coast region south of San Francisco Bay.

*P. m. sonoriensis* (LeC.). Size small; color ochraceous buff: Great Basin region.

*P. m. rufinus* (Merriam). Like *P. m. sonoriensis*, but darker: southern Rocky Mountain region.

Fig. 164.—*Peromyscus leucopus* (*Rhoads*).

*P. m. nebrascensis* (Coues). Like *P. m. sonoriensis:* eastern base of the Rockies from Canada to western Texas.

*P. m. luteus* Osg. Like *P. m. nebrascensis*, but smaller: western South Dakota to Kansas.

*P. m. bairdi* (Hoy & Kennicott). Color very dark; back black; size like *P. m. luteus:* prairie region of the upper Mississippi Valley; south to Oklahoma; east to eastern Ohio; north to Manitoba.

*P. m. pallescens* (Allen). Like *P. m. bairdi*, but smaller (length 126 mm.) and somewhat paler: central Texas.

*P. polionotus* (Wagner). Size very small; length 130 mm.; tail 47 mm.; hind foot 16 mm.; color uniformly brownish fawn; under parts creamy white; feet and forelegs white; tail mostly bicolor: southeastern States.

*Subspecies of P. polionotus*

*P. p. polionotus* (Wag.). Open fields of northern Florida and southern Georgia.

*P. p. niveiventris* (Chapman). Size larger and color paler: sandy beach region of eastern Florida.

*P. p. rhoadsi* Bangs. Length 124 mm.; color darker than *P. niveiventris:* southwestern Florida.

*P. p. albifrons* Osg. Like *P. p. rhoadsi:* coast of western Florida and Alabama.

*P. leucopus* (Rafinesque). Common white-footed or deer mouse (Fig. 164). Color brownish gray above; under parts and feet pure white; length 166 mm.; tail 77 mm.; hind foot 20 mm.: eastern and central States; very common.

*Subspecies of P. leucopus*

*P. l. leucopus* (Raf.). Western Kentucky southward to southern Louisiana; westward to Oklahoma; eastward through Mississippi and Alabama to eastern Virginia.

*P. l. noveboracensis* (Fischer). Larger and paler: north-central and eastern States; westward to Kansas and South Dakota; southward to southern Missouri and North Carolina; northward to central Minnesota, Ontario and Maine.

*P. l. fusus* Bangs. Size larger; length 194 mm.: Martha's Vineyard.

*P. l. aridulus* Osg. Like *P. l. noveboracensis*, but paler and larger; length 184 mm.: Kansas to South Dakota and Montana.

*P. l. texanus* (Woodhouse). Color darker; molar teeth small: southern Texas and eastern Mexico.

*P. l. tornillo* (Mearns). Like *P. l. texanus*, but larger and paler and with heavier: western Texas and eastern New Mexico.

*P. l. arizonæ* (Allen). Like *P. l. tornillo*, but darker: southeastern Arizona and southwestern New Mexico.

*P. l. ochraceus* Osg. Color ochraceous buff: eastern Arizona.

*P. gossypinus* (LeC.). Cotton mouse. Color rufescent cinnamon above; under parts heavily mixed with blackish; tail not distinctly bicolor; feet white; length 181 mm.; tail 81 mm.; hind foot 23 mm.: southeastern and south-central States.

### *Subspecies of P. gossypinus*

*P. g. gossypinus* (LeC.). Coast region and pedeplain of southern States from Virginia to central Louisiana, except peninsular Florida.

*P. g. megacephalus* (Rhoads). Larger and paler: northern Alabama and western Tennessee to eastern Oklahoma and Texas and western Louisiana.

*P. g. palmarius* Bangs. Small and paler: peninsular Florida.

*P. boylei* (Baird). Color light brown above; feet white; tail long, equal to or longer than the head and body; length 197 mm.; tail 103 mm.; hind foot 22 mm.: southwestern States and Mexico.

### *Subspecies of P. boylei*

*P. b. boylei* (Baird). West slopes of the Sierras from Yosemite to Mount Shasta, thence along the east slope of the Coast Range southward to San Francisco Bay.

*P. b. rowleyi* (Allen). Like *P. b. boylei*, but paler: mountains of southern California to western Texas; southern Nevada, Utah and Colorado.

*P. b. attwateri* Allen. Like *P. b. boylei;* hind foot larger: central Texas to Arkansas and Missouri.

*P. pectoralis laceianus* Bailey. Color pinkish buff above mixed with dusky; under parts pure white; length 187 mm.; tail 96 mm.; hind foot 23 mm.: west-central Texas and Mexico.

*P. truei* (Shufeldt). Rock mouse. Color ochraceous buff above, mixed with fine dusky lines; under parts creamy white; feet white; tail slightly bicolor; length 186 mm.; tail 92 mm.; hind foot 23 mm.; ears very large, equal in length to hind foot: Pacific and southwestern States and Mexico.

*Subspecies of P. truei*

*P. t. truei* (Schuf.). Eastern California to eastern New Mexico and southeastern Colorado.

*P. t. gilberti* (Allen). Size larger and color darker: mountains of interior California and the coast south of San Francisco Bay; northward to central Oregon.

*P. t. martirensis* (Allen). Size large; tail long: mountains of southwestern California.

*P. nuttalli* (Harlan). Golden mouse. Color ochraceous above, creamy white suffused with ochraceous below; ears ochraceous; length 181 mm.; tail 85 mm.; hind foot 20 mm.: southeastern Virginia southwestward to northern Alabama, thence north to southern Kentucky.

*Subspecies of P. nuttalli*

*P. n. nuttalli* (Harl.). Distribution as given above.

*P. n. aureolus* (Audubon & Bachman). Size smaller: southeastern States, from North Carolina, east of the mountains, to northern Florida; Gulf slope to eastern Texas and north into Missouri.

*P. floridanus* (Chap.). Size large; color pale ochraceous buff; under parts white; length 200 mm.; tail 86 mm.; hind foot 26 mm.; plantar tubercles 5: central Florida, from coast to coast.

*P. crinitus* (Merr.). Color buff above, white beneath; mammæ 4; length 176 mm., tail 95 mm.; hind foot 21 mm.: Great Basin, from eastern Oregon and southern Idaho to Lower California.

*P. californicus* (Gambel). Size very large, being the largest in the country; length 243 mm.; tail 133 mm.; hind foot 27 mm.; color russet above, mixed with black; under parts creamy white; ears very large: coast region of California from San Francisco into Lower California.

*P. eremicus* (Baird). Color ochraceous buff above; white beneath; tail long; length 183 mm.; tail 101 mm.; hind foot 20 mm.: southeastern California to western Texas.

*P. taylori* (Thomas). Size very small, being the smallest of the genus, and one of the smallest of rodents; length 97 mm.; tail 38 mm.; hind foot 14 mm.; color pale drab; under parts smoky gray: coastal region of Texas.

FIG. 165.—*Oryzomys palustris* (*after Stone & Cram*).

FIG. 166.—*Sigmodon hispidus* (*after Stone & Cram*).

**4. Oryzomys** Baird. Body long and slender; tail long; belly not pure white; fur coarse: 50 species, mostly in Mexico and Central America; 1 species in the United States; the litter numbers 3 to 7.

*O. palustris* (Harlan). Rice or marsh rat (Fig. 165). Body dark brown above, paler beneath; length 240 mm.; tail 115 mm.; hind foot 30 mm.: southeastern States; in coastal marshes and wet lands.

*Subspecies of O. palustris*

*O. p. palustris* (Har.). Southern New Jersey to South Carolina.

*O. p. oryzivorus* (Audubon & Bachman). Color browner (less gray); body slenderer: South Carolina to Florida and southern Texas.

*O. p. coloratus* Bangs. Color rich reddish brown; size large; length 301 mm.: southern Florida.

**5. Sigmodon** Say & Ord. Body large and rat-like; ears large; tail long; molars with crowns flattened and showing S-shaped loops: 11 species, mostly in Mexico; 1 species in the United States.

*S. hispidus* S. & O. Cotton rat (Fig. 166). Color yellowish brown above sprinkled with black, whitish beneath; fur long and coarse; length 252 mm.; tail 102 mm.; hind foot 32 mm.: south Atlantic and Gulf States; westward to Kansas, Texas and into Mexico.

*Subspecies of S. hispidus*

*S. h. hispidus* S. & O. North Carolina to Florida and Louisiana.

*S. h. littoralis* Chapman. Color darker: southeastern Florida.

*S. h. spadicipygus* Bangs. Size smaller; rump rufous: southern Florida.

*S. h. texianus* (Audubon & Bachman). Size smaller; rump reddish: Texas, Oklahoma and Kansas.

*S. h. berlandieri* Baird. Size small; colors pale: western Texas and eastern New Mexico.

*S. h. eremicus* Mearns. Color yellowish: along the lower Colorado.

*S. h. arizonæ* Mearns. Size large; length 320 mm.; colors pale: Arizona.

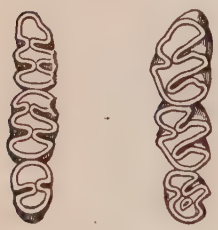


Fig. 167.—Non-tuberculate teeth of *Neotoma*.

**Subfamily 3. Neotominæ.**—Wood rats; mountain rats. Body large, but slender; eyes and ears large; tail long; crowns of molar teeth flattened (Fig. 167): 5 genera, all in North America, 1 in the United States.

**Neotoma** Say and Ord. With the characters of the subfamily: 28 species, about 10 in the United States, mostly in the western States; most species live in rocky or mountainous regions, building large conical nests of sticks, often in trees above the ground, to which well-defined runways lead. Their food consists of grass, bark, seeds, fruit, etc. Wood rats have several litters a year of from 2 to 5 young each. They sometimes enter houses and resemble the common rat, but may be distinguished by usually greater size, larger ears and eyes, a shorter and fully furred, bicolor tail and white feet and under parts.

**Key to the United States Species of Neotoma**

$a_1$ Tail cylindrical and not bushy.
  $b_1$ Size large; length more than 320 mm.
    $c_1$ In the eastern and central States.
      $d_1$ From Pennsylvania to Alabama.....*N. pennsylvanica.*
      $d_2$ In the Gulf States; Texas to South Dakota.....*N. floridana.*
    $c_2$ In the far-western States.
      $d_1$ Hind feet white.
        $e_1$ Not on the Pacific coast; in the States on the Mexican border.
          $f_1$ Throat and breast pure white.....*N. micropus.* *N. albigula.*
          $f_2$ Throat and breast plumbeous.....*N. mexicana.*
        $e_2$ In the Pacific coast region.....*N. intermedia.*
      $d_2$ Hind feet dusky.....*N. fuscipes.*
  $b_2$ Size small; length under 320 mm.
    $c_1$ From California to Utah.....*N. desertorum.*
    $c_2$ In Arizona and New Mexico.....*N. lepida.*
$a_2$ Tail flattened and bushy.....*N. cinerea.*

*N. pennsylvanica* Stone. Wood or cave rat. Color grayish buff above and white beneath, darkest middorsally; feet white; length 430 mm.; tail 198 mm.; hind foot 43 mm.: Appalachian Mountain region from the Hudson River in southern New York to Alabama; Transition zone; nocturnal animals nesting in caves and rocky crevices, where they heap together a great mass of sticks and leaves, in which is the nest; probably omnivorous.

*N. floridana* (Ord.). Color pale cinnamon above; underneath parts and feet white; length 409 mm.; tail 189 mm.; hind foot 38 mm.; tail slightly bicolor and scantily haired: southern and central States.

*Subspecies of N. floridana*

*N. f. floridana* (Ord.). Atlantic coast region from South Carolina to Sebastian, Florida.

*N. f. rubida.* Bangs. Color redder: lower Mississippi Valley, northward to Arkansas, and the Gulf coast from Alabama to Texas.

*N. f. illinoensis* Howell. Color grayer; tail bicolor: southern Illinois to northern Arkansas.

*N. f. attwateri* Mearns. Color darker and teeth smaller; tail white beneath, sharply bicolor: central Texas to Missouri.

*M. f. baileyi* Merriam. Color grayer; fur longer; tail shorter, bicolor: South Dakota to Oklahoma.

*N. micropus* Baird. Color pale drab; under parts white; tail blackish above, grayish beneath; length 351 mm.; tail 163 mm.; hind

foot 41 mm.: central and western Texas and New Mexico into Mexico; northward into Kansas.

*N. albigula* Hartley. Color pinkish buff above; under parts and feet white; tail sharply bicolor; length 328 mm.; tail 152 mm.; hind foot 33 mm.: southwestern States.

*Subspecies of N. albigula*

*N. a. albigula* Hart. Southwestern Texas to western Arizona and into Mexico.

*N. a. venusta* True. Size larger: western Arizona and southeastern California.

*N. a. warreni* Merr. Color decidedly grayer: northeastern New Mexico and southeastern Colorado.

*N. mexicana* Baird. Color grayish buff; under parts dull white; feet white; tail brownish above, white below; length 327 mm.; tail 149 mm.; hind foot 34 mm.; fur on throat and breast plumbeous: deserts of the southwest.

*Subspecies of N. mexicana*

*N. m. mexicana* Baird. Western Texas, southern New Mexico and Arizona.

*N. m. fallax* Merr. Size larger; color grayer: mountains of Colorado and New Mexico.

*N. m. pinetorum* Merr. Size larger; color less gray: central and eastern Arizona.

*N. desertorum* Merr. Size small; ears large; fur long; color pinkish buff; belly and feet white; tail bicolor; length 293 mm.; tail 131 mm.; hind foot 30 mm.: deserts of Nevada, Utah and southern California.

*N. lepida* Thomas. Color yellowish buff above; under parts creamy or pinkish white; feet white; length 286 mm.; tail 136 mm.; hind foot 29 mm.: New Mexico and Arizona.

*Subspecies of N. lepida*

*N. l. lepida* Merr. Northern New Mexico and Arizona.

*N. l. stephensi* Goldman. Size larger; color darker and grayish instead of yellowish: central Arizona and western New Mexico.

*N. fuscipes* Baird. Size large; length 438 mm.; tail 209 mm.; hind foot 42 mm.; color ochraceous buff, very dark middorsally; throat and chest pure white; belly creamy or pinkish buff; forefeet and toes of hind feet white; hind feet dusky: Pacific slope.

*Subspecies of N. fuscipes*

*N. f. fuscipes* Baird. Pacific coast region from San Francisco Bay to Salem, Oregon.

*N. f. streatori* Merr. Smaller; color paler; tail sharply bicolor: west slopes of the Sierra Nevadas.

*N. f. annectens* Elliott. Like *N. f. fuscipes*, but with distinctive cranial characters: from San Francisco Bay to Monterey Bay, and inland southward.

*N. f. macrotis* Thomas. Size small; color grayish brown; tail bicolor: coastal region south of Monterey Bay.

*N. cinerea* (Ord.). Color grayish buff above, white beneath; length 390 mm.; tail 160 mm.; hind foot 43 mm.; tail flattened and bushy: northwestern States and British Columbia.

*Subspecies of N. cinerea*

*N. c. cinerea* (Ord.). Rocky Mountains from northern Montana and the Dakotas to Arizona; central Nevada and western California.

*N. c. occidentalis* Baird. Color darker: British Columbia to northern California; eastward into Idaho and northern Nevada.

*N. c. fusca* True. Color very dark: coastal region west of the Cascades in Oregon.

*N. c. arizonæ* Merr. Size very small: northern Arizona and New Mexico and southern Utah and Colorado.

*N. intermedia* Rhoads. Color grayish brown; under parts white; feet white; tail black above, dull white below; length 325 mm.; tail 160 mm.; hind foot 31 mm.: coastal region of California from Monterey Bay southward to Cape San Lucas.

**Subfamily 4. Microtinæ.** Meadow or field mice; voles; lemmings. Body stout, with a thick head and short ears and a short tail; crowns of molars flattened and showing triangular loops of enamel: distribution circumpolar; over 70 species in the United States; very common animals, living in a great variety of locations, but most abundant in well-watered grass lands, all remarkable for their great fecundity, breeding usually throughout the year; their food consists mainly of green vegetation, roots and bark and they are often a plague to the agriculturist. This subfamily includes the Scandinavian lemmings, which at irregular intervals migrate across the country in great armies, eventually reaching the sea and all drowning, and also the Alpine marmot, which lives in the high mountains and hibernates 8 or 10 months of the year.

**Key to the United States Genera of Microtinæ**

$a_1$ Tail round.
  $b_1$ Molars without roots (prongs) (Fig. 168).
    $c_1$ Lower incisors long; their roots extending under the posterior molars.
      $d_1$ Plantar tubercles mostly 6.
        $e_1$ Mammæ mostly 8.....1. *Microtus.*
        $e_2$ Mammæ 4.....3. *Pitymys.*
      $d_2$ Plantar tubercles 5.
        $e_1$ Mammæ 8.....2. *Lagurus.*
        $e_2$ Mammæ 6.....4. *Neofiber.*
    $c_2$ Lower incisors short, their roots ending on the inner side of the molars.....5. *Synaptomys*
  $b_2$ Molars with roots (prongs) (Fig. 169).
    $c_1$ Back not red or chestnut in color; molars large.....6. *Phenacomys.*
    $c_2$ Back red in color; molars small and weak.....7. *Evotomys.*
$a_2$ Tail flattened laterally; size large; muskrats.....8. *Fiber.*

**1. Microtus** Schrank. Meadow or field mice; voles. Cranium slender; lower incisors very long, with roots ending on the outer side

FIG. 168.—Lower jaw of *Microtus pennsylvanicus*, showing the molars without roots but open below so that they grow continuously (*from Miller*).

of the molars, which are rootless (Fig. 168); tail longer than the hind foot; plantar tubercles 5 or 6; thumb with nail: over 150 species, ranging

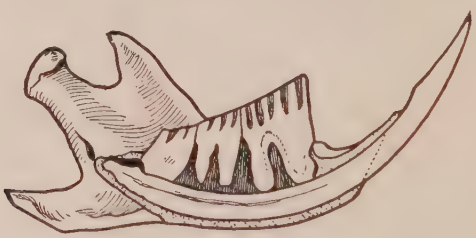


FIG. 169.—Lower jaw of *Phenacomys orophilus*, showing the molars possessing roots (*from Miller*).

southward to the tropics; 30 species in the United States, mostly northerly in range; both diurnal and nocturnal animals which build

nests under bush heaps or stones, to which runways, often more or less subterraneous, lead; they feed on grasses, roots and bark, and also at times on grain, and they do not hibernate. Field mice at times become excessively numerous in a district, when they may destroy forage crops, and also fruit trees and shrubbery by gnawing off the bark at the base of the trunk. Several litters, numbering from 4 to 11 each, are born annually.

### Key to the United States Species of Microtus

$a_1$ Plantar tubercles 6.
  $b_1$ Mammæ 8.
    $c_1$ In the eastern and central States.
      $d_1$ In the States east of the Mississippi.
        $e_1$ Nose not yellow.
          $f_1$ Present from the Atlantic to the Rockies... *M. pennsylvanicus.*
          $f_2$ On Muskeget Island, Massachusetts..... *M. breweri.*
        $e_2$ Nose conspicuously yellow..... *M. chrotorrhinus.*
      $d_2$ In the States between the Mississippi and the Rockies.
        $e_1$ Present from the Atlantic to the Rockies..... *M. pennsylvanicus.*
        $e_2$ In the Black Hills, South Dakota..... *M. longicaudus.*
        $e_3$ In the Rocky Mountains..... *M. mordax.*
    $c_2$ In the Pacific States.
      $d_1$ Throughout California..... *M. californicus.*
      $d_2$ In the San Joaquin and Sacramento Valleys..... *M. edax.*
      $d_3$ In the southern Sierras..... *M. dutcheri.*
      $d_4$ In Idaho and Nevada..... *M. nanus.*
      $d_5$ In Oregon and Washington.
        $e_1$ From Puget Sound to Yaquina Bay..... *M. townsendi.*
        $e_2$ In the Willamette Valley..... *M. canicaudus.*
        $e_3$ In northern California and southern Oregon... *M. angusticeps.*
        $e_4$ In eastern Oregon in Utah..... *M. montanus.*
        $e_5$ In the Olympic Mountains..... *M. macrurus.*
  $b_2$ Mammæ 4; in Arizona..... *M. mogollonensis.*
$a_2$ Plantar tubercles 5.
  $b_1$ Mammæ 8.
    $c_1$ In the Boreal zone of the Rockies and Cascades..... *M. richardsoni.*
    $c_2$ In the Puget Sound region..... *M. oregoni.*
    *M. serpens.*
  $b_2$ Mammæ 6.
    $c_1$ In the central Mississippi Valley..... *M. ochrogaster.*
    $c_2$ From South Dakota and Kansas to the Rockies..... *M. haydeni.*
    $c_3$ In Louisiana..... *M. ludovicianus.*
    $c_4$ In Minnesota and South Dakota..... *M. minor.*

*M. pennsylvanicus* (Ord.). Common field or meadow mouse (Fig. 170). Color chestnut brown above, darker middorsally, grayish beneath; feet brownish; length 180 mm.; tail 50 mm.; hind foot 21 mm.; mammæ 8: eastern and central States; southward to North Carolina; westward to the Rockies; northward to Hudson Bay; common in meadows.

FIG. 170.—*Microtus pennsylvanicus* (*after Stone & Cram*).

*Subspecies of M. pennsylvanicus*

*M. p. pennsylvanicus* (Ord.). Transition zone from the Atlantic coast to the Great Plains.

*M. p. nigrans* Rhoads. Larger, with notably larger hind feet and darker coloration: coast region of northern North Carolina and southern Virginia.

*M. p. fontigenus* Bangs. Size smaller: eastern Canada, Hudsonian zone.

*M. p. acadicus* Bangs. Smaller and paler: Nova Scotia and Prince Edwards Island.

*M. p. modestus* (Baird). Color paler, more yellowish: Rocky Mountains and western plains from New Mexico to British Columbia; Transition zone.

*M. breweri* (Baird). Color pale grayish; fur long and coarse; length 182 mm.; tail 54 mm.; hind foot 22 mm.: Muskeget Island, Massachusetts.

*M. ochrogaster* (Wagner). Prairie meadow mouse. Color grizzly gray; belly fulvous; fur coarse; length 127 mm.; tail 32 mm.; hind foot 20 mm.; mammæ 6: southern Wisconsin to Oklahoma and eastern Kansas and Nebraska; eastward to Indiana; common in dry prairie land.

*M. chrotorrhinus* (Miller). Color glossy brown; nose, ears and rump conspicuously yellowish; length 165 mm.; tail 45 mm.; hind foot 19 mm.: Mount Washington, the Catskills and into Canada; Hudsonian zone.

*M. haydeni* (Baird). Color light gray; belly silvery white; length 180 mm.; tail 47 mm.; hind foot 22 mm.: western South Dakota to Kansas; westward into southern Montana, Wyoming and eastern Colorado; in dry prairies.

*M. longicaudus* (Merriam). Color dark brown above, whitish below; length 180 mm.; tail 65 mm.; hind foot 21 mm.: Boreal cap of Black Hills.

*M. ludovicianus* Bailey. Color dark gray above, dark buff below: length 164 mm.; tail 33 mm.; hind foot 19 mm.: coast prairies of Louisiana.

*M. minor* (Merr.). Size very small; length 133 mm.; tail 36 mm.; hind foot 16 mm.; color peppery gray above, buff below: northern border of the Great Plains from Minneapolis to eastern North Dakota and Alberta.

*M. californicus* (Peale). Color dull buff or brownish; belly whitish; length 171 mm.; tail 49 mm.; hind foot 21 mm.; mammæ 8; fur coarse: Pacific slope; in dry meadows.

*Subspecies of M. californicus*

*M. c. californicus* (Peale). California west of the Sierras, from San Diego to southern Oregon.

*M. c. vallicola* Bailey. Larger and darker: valleys east of the Sierras.

*M. c. constrictus* Bailey. Smaller and grayer: coast region near Cape Mendocino.

*M. edax* (LeConte). Color dark gray; belly whitish; length 217 mm.; tail 72 mm.; hind foot 25 mm.; feet large and stout: bottom of the San Joaquin and Sacramento Valleys; Lower Austral zone.

*M. townsendi* (Bachman). Color dark brown; belly grayish; tail black; length 226 mm.; tail 66 mm.; hind foot 26 mm.; ears conspicuous: region west of the Cascades from British Columbia to Yaquina Bay, Oregon; Transition zone.

*M. mordax* (Merr.). Color dark gray; belly whitish; tail long; feet small; length 200 mm.; tail 77 mm.; hind foot 22 mm.: Rocky Mountains from latitude 60 to New Mexico and the eastern slopes of the Cascades and Sierras; common on the banks of mountain streams; Hudsonian and Canadian zones.

*M. macrurus* Merr. Color dark brownish gray; length 220 mm.; tail 88 mm.; hind foot 24 mm.: Olympic Mountains to Alaska; along cold streams.

*M. angusticeps* Bailey. Color dark brownish gray, darkest on the face; tail distinctly bicolor; length 170 mm.; tail 56 mm.; hind foot 22; skull very narrow: coastal region of northwestern California and southern Oregon.

*M. montanus* (Peale). Color dark gray; belly whitish; length 175 mm.; tail 52 mm.; hind foot 21 mm.: eastern Oregon; northern California to Nevada.

*Subspecies of M. montanus*

*M. m. arizonensis* Bailey. Color more ferrugineous: eastern Arizona; Transition zone.

*M. m. rivularis* Bailey. Larger and lighter colored: Washington County, Utah; Lower Sonoran zone.

*M. nanus* (Merr.). Color grizzled gray; length 151 mm.; tail 41 mm.; hind foot 18 mm.: Rocky Mountains from central Idaho to central Nevada and southern Colorado; Canadian zone.

*M. n. canescens* Bailey. Color lighter and clearer: northern Washington and British Columbia, east of the Cascades.

*M. canicaudus* Miller. Color bright yellowish brown; belly whitish gray; tail uniform grayish; length 135 mm.; tail 33 mm.; hind foot 20 mm.: Wiliamette Valley and southern Washington; Transition zone.

*M. dutcheri* Bailey. Color dark brown; belly buffy brown; tail bicolor; length 167 mm.; tail 35 mm.; hind foot 20 mm.: Hudsonian zone of the southern Sierras; in wet alpine meadows.

*M. richardsoni* (DeKay). Color grayish sepia; belly whitish; tail long; feet large; fur long and heavy; length 234 mm.; tail 81 mm.; hind foot 29 mm.: Boreal zones of the Rockies and the Cascades.

*Subspecies of M. richardsoni*

*M. r. macropus* (Merr.). Color dark sepia; size smaller: Rockies from the Wasatch into Canada.

*M. r. arvicoloides* (Rhoads). Color dark sepia: Boreal zone of the Cascades.

*M. mogollonensis* (Mearns). Color dull rusty brown; belly cinnamon or gray; mammæ 4; length 131 mm.; tail 28 mm.; hind foot 18 mm.: plateau country of central Arizona.

*M. oregoni* (Bach.). Color dark brown and grizzled; belly dusky; length 140 mm.; tail 42 mm.; hind foot 17 mm.: Pacific coast region from northern California to Puget Sound; in dry open forests.

*M. serpens* Merr. Color sooty gray; belly dusky; length 130 mm.; tail 31 mm.; hind foot 18 mm.: northern Washington and southern British Columbia between the Cascades and Puget Sound.

**2. Lagurus** Gloger. Similar to *Microtus;* cranium low and wide; plantar tubercles 5; mammæ 8; colors pale; fur lax; tail very short; size small: 4 species.

L. *curtatus* (Cope). Color buffy gray; whitish beneath; length 141 mm.; tail 27 mm.; hind foot 17 mm.: eastern California and western Nevada; Transition zone.

*L. pallidus* (Merriman). Color buffy gray; length 121 mm.; tail 20 mm.; hind foot 18 mm.: western Dakota and Montana, in high prairies.

*L. pauperrimus* (Cooper). Color buffy gray; length 115 mm.; tail 20 mm.; hind foot 16 mm.: eastern Washington and Oregon; Transition zone.

**3. Pitymys** McMurtrie. Like *Microtus;* cranium flat and wide; plantar tubercles 5; mammæ 4; fur short and dense; ears very small; tail very short: 3 species, 1 in Mexico.

*P. pinetorum* (LeConte). Pine mouse. Color bright russet brown; belly dusky; ears concealed in the fur; length 113 mm.; tail 18 mm.; hind foot 15 mm.: Georgia and Mississippi to Indiana and New York; common in fields and open woods. The pine mouse has an underground nest and raises several litters of from 1 to 4 young a year; the runways are also underground, and often resemble mole's tunnels; the food consists of grasses, roots and bark, and great damage is often done to orchards and gardens.

*Subspecies of P. pinetorum*

*P. p. pinetorum* (LeConte). Georgia and the Carolinas.

*P. p. scalopsoides* (Audubon & Bachman). Size larger; color darker: North Carolina to New York; westward to Illinois.

Fig. 171.—Lower jaw of *Synaptomys cooperi* (*from Miller*).

*P. p. auricularis* Bailey. Colors dark and rich; ears large: Mississippi to Indiana, between the Alleghany Mountains and the Mississippi River.

*P. nemoralis* (Bailey). Color full chestnut; belly washed with bright cinnamon; length 130 mm.; tail 24 mm.; hind foot 18 mm.: westward of the Mississippi River from Arkansas to Iowa.

**4. Neofiber** True. Size very large; tail long; plantar tubercles 5; mammæ 6; skull massive: 1 species.

*N. alleni* True. Color dark brown; belly pale buff; length 320 mm.; tail 121 mm.; hind foot 14 mm.: eastern and central Florida; in marshes.

**5. Synaptomys** Baird. Lemmings. Each upper incisor with a longitudinal groove in its outer surface; lower incisors extend back along the inner side of the molars (Fig. 171), which are without roots; tail very short, covered with short hairs: about 4 species in the United States.

*S. cooperi* Baird (Fig. 172). Body small and mouse-like, but with a very much shorter tail than the house-mouse, grizzled gray in color; length 120 mm.; tail 18 mm.; hind foot 18 mm.; head very large: northern and central States and Canada; southward to North

Carolina; westward to Michigan and Kansas; in woody marshes and swamps; Boreal and Transition zones; rare.

*S. fatuus* Bangs. Similar to *S. cooperi*, but with narrower upper incisors and a smaller skull: Maine and New Hampshire, and northward.

*S. helaletes* Merriam. Similar to *S. cooperi*, but with larger feet and a longer tail: Dismal Swamp, Virginia.

*S. sphagnicola* Preble. Color sepia brown mixed with black; under parts grayish white; length 132 mm.; tail 17 mm.; hind foot 17 mm.: Mount Washington, New Hampshire.

FIG. 172.—*Synaptomys cooperi (after Stone & Cram).*

**6. Phenacomys** Merriam. Similar to *Microtus;* molars with 2 roots (Fig. 169) and large and strong; front teeth without grooves; body short and thick; tail short; ears just appearing above the fur: 9 species, all North American; 6 species in the United States.

*P. latimanus* Merriam. Color yellowish brown above, whitish below; face suffused with reddish; length 150 mm.; tail 35 mm.; hind foot 20 mm.: Labrador to the north shore of Lake Superior.

*P. orophilus* Merr. Mountain lemming. Color light grayish brown, tinged with yellow; whitish below; feet pure white; length 146 mm.; tail 38 mm.; hind foot 19 mm.: Rocky Mountains from British Columbia to New Mexico; westward to central Oregon; Canadian zone; similar in habits to *Microtus*.

*P. olympicus* Elliot. Like *P. orophilus*, but smaller, darker and with a longer tail: Olympic Mountains, Washington.

*P. preblei* Merr. Like *P. orophilus*, but more ochraceous: Longs Peak, Colorado.

*P. albipes* Merr. Color grizzled brown; grayish beneath; feet white; length 168 mm.; tail 62 mm.; hind foot 19 mm.: Humboldt County, California.

*P. longicaudus* True. Color bright rusty brown; feet brown, length 148 mm.: coniferous forests of western Oregon and northwestern California. The mouse is arboreal in habits, building a large nest of twigs from 30 to 100 feet from the ground in which it raises several litters of young a year, numbering from 1 to 4 each.

**7. Evotomys** Coues. Red-back mice. Body small and reddish in color, with a short tail; molars rooted, and small and weak, the lower incisors extending along the outer side of them; incisors without grooves: circumpolar; about 6 species in the United States, which nest in under-

ground burrows in which they raise several broods a year, each numbering from 3 to 8 young; they feed on seeds, roots, etc., and lay up stores for winter use.

*E. gapperi* (Vigors) (Fig. 173). Color bright chestnut above; sides buff, sharply defined from the color of the back; length 140 mm.; tail 40 mm.; hind foot 18 mm.: Canada and northern United States; southward into the Pennsylvania mountains; westward to eastern Oregon; in cool forests and swamps.

Fig. 173.—*Evotomys gapperi* (*after Stone & Cram*).

*Subspecies of E. gapperi*

*E. g. gapperi* (Vigors). Pennsylvania to Canada; westward to the Rockies.

*E. g. ochraceus* Miller. Color pale rusty rufous: Upper Boreal zone of White Mountains, New Hampshire and eastward.

*E. g. rhoadsi* Stone. Ears large, projecting conspicuously above the fur; color dark chestnut; skull and teeth heavy: southern New Jersey to New York.

*E. g. loringi* Bailey. Size very small; colors bright: Minnesota and eastern Dakotas, along the edge of timbered valleys.

*E. g. galei* Merriam. Size larger; colors darker: Boreal zone of Colorado to northern Montana.

*E. g. saturatus* Rhoads. Size larger; colors lighter: Blue Mountains, Oregon; northern Idaho.

*E. carolinensis* Merr. Color dark chestnut, fading into lighter; length 150 mm.; tail 45 mm.; hind foot 21 mm.: mountain forests of the southern Alleghenies.

*E. brevicaudus* Merr. Color pale reddish, mixed with black; belly cream; length 125 mm.; tail 31 mm.; hind foot 19 mm.: Black Hills; Boreal zone.

*E. idahoensis* Merr. Color pale hazel, lined with black; length 153 mm.; tail 48 mm.; hind foot 20 mm.: mountains of south-central Idaho.

*E. mazama* Merr. Color cinnamon rufous; length 157 mm.; tail 52 mm.; hind foot 18 mm.: crest of the Cascades in Oregon.

*E. obscurus* Merr. Color olive gray above; length 155 mm.; tail 47 mm.; hind foot 17 mm.: eastern Oregon and northeastern California.

*E. californicus* Merr. Color sepia above, dark chestnut on the back; length 161 mm.; tail 50 mm.; hind foot 21 mm.: coast of Oregon and northern California.

*E. occidentalis* Merr. Color dark chestnut above; sides gray; under parts salmon buff; length 145 mm.; tail 45 mm.; hind foot 18 mm.: Puget Sound and coast region of Washington.

*E. nivarius* Bailey. Color light chestnut above; sides gray; length 150 mm.; tail 50 mm.; hind foot 18 mm.: high peaks of the Olympic Mountains, Washington.

**8. Fiber** Cuvier (*Ondatra* Link). Muskrats. Body large and stout; legs short; feet large, the feet and toes being fringed with short, stiff hairs; hind toes partly webbed; tail flattened laterally, with few hairs; fur thick, with longer hairs projecting from it; anal musk glands present: 3 species, with many subspecies, all in North America; the most important fur-bearing animals in the country.

*F. zibethicus* (L.). Common muskrat. Color brown, variable, darker dorsally, whitish beneath; length 560 mm.; tail 250 mm.; hind foot 81 mm.: North America, from the Arctic barrens and Hudson Bay to the Mexican boundary; very common. The animals live in swamps and ponds and streams, in the banks of which they may burrow to form the nest where the young are born. They also form large dome-shaped houses two or three feet high and five or six feet in diameter by heaping up sticks and reeds, the upper portion of which contains a chamber above the level of the water where they spend much of the winter. Their food consists of roots and water-plants, and also shell-fish and other small animals; they raise several litters annually of from 3 to 13 each, and do not hibernate.

*Subspecies of F. zibethicus*

*F. z. zibethicus* (L.). Northeastern and central States; westward to Minnesota and the Great Plains; southward to Georgia and Arkansas, except along the Atlantic seaboard south of Delaware Bay.

*F. z. macrodon* Merriam. Colors rich and bright; black phase often common; in size the largest of the genus; length 620 mm.; tail 274 mm.; hind foot 88: Atlantic coast region from Delaware Bay to Pamlico Sound.

*F. z. osoyoosensis* Lord. Color glossy brown to black: Puget Sound region and Rocky Mountains.

*F. z. occipitalis* Elliot. Paler and more reddish than *F. z. osoyoosensis:* northern Willamette Valley and coast of Oregon.

*F. z. mergens* Hollister. Color pale; size large: northern part of Great Basin.

*F. z. pallidus* Mearns. Color uniform rusty red; size small: Colorado River Valley; eastward to Rio Grande.

*F. z. ripensis* Bailey. Color light brown; size small: Pecos Valley, Texas.

*F. z. cinnamominus* Holl. Color pale, with much red: Great Plains from Manitoba to northern Texas; east to central Iowa.

*F. rivalicius* Bangs. Color dark brownish black; length 547 mm.; tail 233 mm.; hind foot 78 mm.: coast region of Louisiana; moults twice annually.

**Family 2. Geomyidæ.**—Pocket gophers. Thick-bodied rodents with short legs, fore feet fitted for digging, small ears and eyes, and a pair of large fur-lined cheek-pouches which are not connected with the mouth but open on the cheeks at the sides of the mouth; dentition 1/1, 0/0, 1/1, 3/3: 9 genera and about 100 species, all American, half of which occur in the southern United States, the rest in Mexico and Central America. The animals live in burrows in the ground, in which they dig with great facility, using both the strong, clawed fore feet and the incisors. Their food consists chiefly of roots, tubers and grasses, and they frequently do great damage to potato and vegetable fields. The cheek-pouches are useful in carrying food to their winter store houses, substances being put into them with their fore feet. They are mostly nocturnal and live in communities and do not hibernate; the young number from 1 to 7 in a litter.

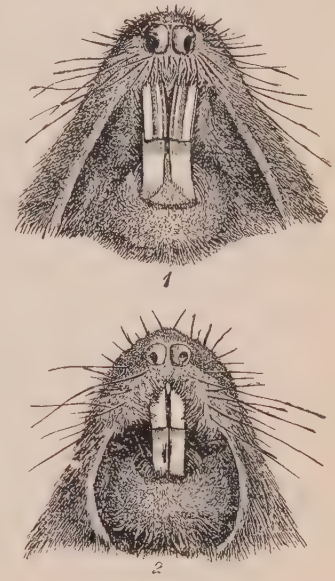


FIG. 174.—Incisors of (1) *Geomys bursarius* and (2) *Thomomys talpoides* (*from Merriam*).

**Key to the Genera of Geomyidæ of the United States**

$a_1$ Outer surface of the upper incisors grooved (Fig. 174).
  $b_1$ Upper incisors with 2 grooves each.....1. *Geomys.*
  $b_2$ Upper incisor with a single deep groove.....2. *Cratogeomys.*
$a_2$ Outer surface of the upper incisors not grooved or with a single fine groove.....3. *Thomomys.*

**1. Geomys** Rafinesque. Upper incisors with a large groove near the middle and one near the median margin; ears rudimentary; fore claws very large: 11 species, all in the United States.

*G. tuza* (Ord.) (Fig. 175). Color brown above, yellowish beneath; tail almost naked; length 249 mm.; tail 89 mm.; hind foot 33 mm.: Georgia, Florida and Alabama; common.

*Subspecies of G. tuza*

*G. t. tuza* (Ord.). Pine barrens of Georgia; Austroriparian zone.

*G. t. mobilensis* Merriam. Color very dark: Alabama and Florida.

*G. t. floridanus* (Audubon & Bachman). Size larger; color darker: peninsular Florida.

*G. bursarius* (Shaw) (Fig. 174). Color dark reddish brown; feet white; length 270 mm.; tail 80 mm.; hind foot 35 mm.; upper incisors with 2 grooves: upper Mississippi Valley; southward to eastern Kansas

FIG. 175.—*Geomys tuza (from Merriam).*

and southeastern Missouri; westward into the Dakotas; eastward to Lake Michigan; very common; 1 litter annually of 1 to 7 young.

*G. breviceps* Baird. Color dark russet brown; length 219 mm.; tail 70 mm.; hind foot 28 mm.; size small: lower Mississippi Valley and Gulf coast of Louisiana and Texas; northward into Kansas.

*Subspecies of G. breviceps*

*G. b. sagittalis* Merr. Size smaller: Gulf coast about Galveston Bay.

*G. b. attwateri* Merr. Size larger: coastal plain and islands from Nueces Bay to Matagorda Bay.

*G. texensis* Merr. Color light brown mixed with black; feet and under parts white; length 203 mm.; tail 60 mm.; hind foot 28 mm.: central and southern Texas.

*G. arenarius* Merr. Colors pale; length 258 mm.; tail 88 mm.; hind foot 33 mm.: valley of the upper Rio Grande.

*G. lutescens* Merr. Colors pale drab or fulvous; beneath whitish; length 256 mm.; tail 77 mm.; hind foot 32 mm.: Great Plains from South Dakota to Texas; eastern Wyoming and Colorado; Upper Sonoran zone.

**2. Cratogeomys** Merriam. Upper incisors grooved in the middle: 1 species in the United States.

*C. castanops* Baird. Color yellowish brown; buff beneath; length 295 mm.; tail 77 mm.; hind foot 33 mm.: Great Plains from the Arkansas River into Mexico.

**3. Thomomys** Wied. Outer surface of upper incisors not grooved or with one fine groove near the median margin (Fig. 174); ears distinct but very small; claws moderate: many species, all in the Rocky Mountain or Pacific States or along the Mexican border.

**Key to the Species of Thomomys**

$a_1$ Mammæ in 4 pairs.
  $b_1$ Size large; length 300 mm. or more.
    $c_1$ Color brown above and below ..... *T. bulbivorus.*
    $c_2$ Color gray above, buff below ..... *T. townsendi.*
  $b_2$ Size moderate; length under 260 mm.
    $c_1$ Color more or less yellowish (ochraceous).
      $d_1$ In central and northern California and Oregon ..... *T. bottæ.*
      $d_2$ In the southern Sierras ..... *T. alpinus.*
      $d_3$ In Arizona, New Mexico and Texas ..... *T. fulvus.*
    $c_2$ Color gray or buff ..... *T. perpallidus.*
    $c_3$ Color brown.
      $d_1$ Length over 200 mm.
        $e_1$ In northwestern Washington ..... *T. douglasi.*
        $e_2$ In California and Oregon ..... *T. monticola.*
        $e_3$ In Montana and Idaho ..... *T. fuscus.*
      $d_2$ Length 175 mm ..... *T. hesperus.*
$a_2$ Mammæ in 5 or more pairs.
  $b_1$ Mammæ in 6 pairs.
    $c_1$ Length over 200 mm ..... *T. talpoides.*
    $c_2$ Length 175 mm ..... *T. pygmæus.*
  $b_2$ Mammæ in 7 pairs ..... *T. ocius.*
  $b_3$ Mammæ in 5 pairs.
    $c_1$ In Colorado and Utah ..... *T. fossor.*
    $c_2$ In California, Oregon and Nevada ..... *T. quadratus.*

*T. bottæ* (Eydoux & Gervais). Color yellowish brown, darker towards the head; lips and lining of the pockets white; length 260 mm; tail 89 mm.; hind foot 33 mm.; mammæ 4 pairs: California.

*Subspecies of T. bottæ*

*T. b. bottæ* (E. & G.). Coast region from Freestone to San Diego.

*T. b. laticeps* Baird. Color warmer and brighter: coast region north of Eel River.

*T. b. minor* Bailey. Size smaller; color darker: coast region from Cape Mendocino to Cazadero.

*T. b. leucodon* Merriam. Smaller, lighter: from Fairfield and Placerville to Grants Pass, Oregon.

*T. b. navus* Merr. Much smaller; color lighter: Sacramento Valley.

*T. b. mewa* Merr. Size smaller; color darker: east side of San Joaquin Valley.

*T. b. angularis* Merr. Size large; color light: west side of San Joaquin Valley; also Santa Clara and San Juan Valleys.

*T. bulbivorus* (Richardson). Color dark brown, above and below; length 300 mm.; tail 90 mm.; hind foot 42 mm.; mammæ 4: Willamette Valley.

*T. townsendi* (Bachman). Color dark gray above, buff below; length 305 mm.; tail 100 mm.; hind foot 38 mm.; in dark color phase black all over: southern Idaho and Oregon and northern Nevada.

*T. alpinus* Merr. Color yellowish brown, being darker along the back and lighter on the belly; length 222 mm.; tail 61 mm.; hind foot 30 mm.: upper levels of the southern Sierras.

*T. perpallidus* Merr. Color buff or cream above, whitish beneath; length 241 mm.; tail 84 mm.; hind foot 31 mm.; mammæ 4 pairs: deserts of southern California to New Mexico and Colorado.

### *Subspecies of T. perpallidus*

*T. p. perpallidus* Merr. Colorado desert, southern California.

*T. p. perpes* Merr. Size small; color gray: eastern California from Owens Valley to Hesperia.

*T. p. canus* Bailey. Color grayish buff; size rather large: western and central Nevada.

*T. p. aureus* Allen. Color golden buff; size rather large: southern Nevada and Utah, western Colorado, New Mexico and Arizona.

*T. fulvus* (Woodhouse). Color dark tawny or light chestnut; length 219 mm.; tail 70 mm.; hind foot 30 mm.; mammæ 4 pairs: Arizona to Texas.

### *Subspecies of T. fulvus*

*T. f. fulvus* (Woodh.). Central Arizona and western and central New Mexico.

*T. f. toltecus* Allen. Color paler and grayer: southeastern Arizona and southwestern New Mexico.

*T. talpoides* (Richardson) (Fig. 174). Color dark gray or grayish brown; under parts whitish or pure white; tail white tipped or all white; length 214 mm.; tail 60 mm.; hind foot 28 mm.; mammæ 6 pairs: South Dakota, Colorado and Wyoming northward into Canada.

*Subspecies of T. talpoides*

*T. t. talpoides* (Rich.). Western Montana into Canada.

*T. t. rufescens* Wied. Size large; length 240 mm.; color dark gray: North and South Dakota and Manitoba.

*T. t. clusius* Coues. Size small; color hazel gray: eastern Colorado and Wyoming.

*T. t. bullatus* Bailey. Color pale and bright: eastern Montana and Wyoming and western South Dakota.

*T. ocius* Merr. Color very pale buffy gray, whitish underneath; length 204 mm.; tail 60 mm.; hind foot 26 mm.; mammæ 7 pairs: Green River basin in Wyoming, Colorado and Utah.

*T. pygmæus* Merr. Color hazel-brown; length 177 mm.; tail 46 mm.; hind foot 22 mm.; the smallest species; mammæ 6 pairs: southwestern Wyoming and southeastern Idaho; Transition zone.

*T. fossor* Allen. Color dark brown; length 221 mm.; tail 63 mm.; hind foot 29 mm.; mammæ 5 pairs: mountains of Colorado and Utah; Boreal zone.

*T. quadratus* Merr. Color light russet; length 210 mm.; tail 64 mm.; hind foot 27 mm.; mammæ 5 pairs: northern California, eastern Oregon and Nevada.

*Subspecies of T. quadratus*

*T. q. quadratus* Merr. Eastern Oregon and northern California.

*T. q. fisheri* Merr. Color paler; size smaller: northern Nevada.

*T. douglasi* (Richardson). Color uniform dull hazel; length 215 mm.; tail 64 mm.; hind foot 30 mm.; mammæ 4 pairs: northwest Washington.

*T. monticola* Allen. Color dull hazel above, buff beneath; length 212 mm.; tail 70 mm.; hind foot 27 mm.; mammæ 4: California and Oregon.

*Subspecies of T. monticola*

*T. m. monticola* Allen. Sierra Nevada of California and Nevada; southward to Mammouth Pass.

*T. m. mazama* Merr. Color darker and richer: Cascade and Siskiyou Mountains; southward to the Trinity Mountains; northward to the Columbia.

*T. m. pinetorum* Merr. Nose and cheeks conspicuously gray: mountains on the west side of Sacramento Valley.

*T. fuscus* Merr. Color light brown; length 203 mm.; tail 70 mm.; hind foot 27 mm.; mammæ 4 pairs: Wyoming to Washington and northward into Canada.

*Subspecies of T. fuscus*

*T. f. fuscus* Merr. Western Montana and Wyoming, northern and central Idaho, eastern Oregon and Washington, British Columbia.

*T. f. saturatus* Bailey. Size larger; color darker: higher parts of the Cœur d'Alene Mountains.

*T. hesperus* Merr. Color dark rich auburn; length 175 mm.; tail 54 mm.; hind foot 24 mm.: coast region of northwestern Oregon.

**Family 3. Heteromyidæ.**—Small, slender rodents with a long tail and with a pair of cheek-pouches, which are lined with fur on the inside and open at the side of the mouth on each cheek; eyes and ears usually large; fur harsh in many species, with numerous bristles or spines: 6 genera and about 100 species, all in America, mostly in more or less arid regions of the western States and Mexico.

**Key to the United States Genera of Heteromyidæ**

$a_1$ Teeth 20 in number.....1. *Perognathus.*
$a_2$ Teeth 16 in number.
  $b_1$ Hind foot with 5 toes.....2. *Perodipus.*
  $b_2$ Hind foot with 4 toes.
    $c_1$ Tail with a terminal pencil.....3. *Dipodomys.*
    $c_2$ Tail without terminal pencil.....4. *Microdipodops*

**1. Perognathus** Wied. Pocket mice (Fig. 176). Body slender and murine; tail at least as long or nearly as long as the rest of the body; ears small; legs and feet long; dentition 1/1, 0/0, 2/2, 2/2; molars rooted and tuberculate; upper incisors strongly sulcate; hair harsh in some species and soft in others: many species, all in North America; 25 species and subspecies in the United States, all west of the Mississippi; nocturnal, burrowing animals, dwelling on plains and deserts and feeding on seeds; several litters of young raised annually, numbering from 2 to 8 each.

**Key to the Species of Perognathus**

$a_1$ Fur soft, without bristles; soles of hind feet more or less hairy (except P. formosus).
  $b_1$ Tail moderate in length and not crested.
    $c_1$ Tail equal to or shorter than the head and body.
      $d_1$ In the Great Plains; length under 135 mm.
        $e_1$ Tail about 60 mm. long.
          $f_1$ Color olivaceous.....*P. fasciatus.*

$f_2$ Color buff.
$g_1$ Length about 130 mm.....*P. flavescens.*
$g_2$ Length under 120 mm.....*P. merriami.*
$e_2$ Tail about 50 mm. long.....*P. flavus.*
$d_2$ In the States of the Mexican border.....*P. apache.*
$c_2$ Tail longer than the head and body.
$d_1$ In southern California and Nevada.....*P. panamintinus.*
$d_2$ In the San Joaquin Valley.....*P. longimembris.*
$d_3$ In the Great Basin.....*P. parvus.*
$d_4$ On the plains of the Columbia.....*P. lordi.*
$b_2$ Tail long and heavily crested.....*P. formosus.*
$a_2$ Fur harsh, usually with spiny bristles on the rump; soles of hind feet naked; tail very long and terminating with a penicillate tuft (except P. hispidus).
$b_1$ Fur without bristles.
$c_1$ Tail not crested, shorter than or equal to the head and body.....*P. hispidus.*
$c_2$ Tail crested, longer than the head and body.....*P. penicillatus.*
$b_2$ Fur with spiny bristles.
$c_1$ Ear rounded.
$d_1$ In Arizona to Texas.....*P. intermedius.*
$d_2$ In southern California.....*P. fallax.*
$c_2$ Ear elongate.
$d_1$ Near San Diego.....*P. femoralis.*
$d_2$ In central and southern California.....*P. californicus.*

*P. fasciatus* Wied. Color olivaceous; pure white below; fur soft; soles of feet hairy; length 134 mm.; tail 64 mm.; hind foot 17 mm.: eastern Montana and Wyoming and western Dakota; Upper Sonoran and Transition zones.

*P. flavescens* Merriam. Color buff; white below; feet and legs white; length 129 mm.; tail 61 mm.; hind foot 17 mm.: South Dakota to northern Texas; Upper Austral plains.

*P. merriami* Allen. Color ochraceous buff; belly, feet and fore legs white; length 116 mm.; tail 57 mm.; hind foot 16 mm.: central and southern Texas.

*P. flavus* Baird. Color pinkish buff; pure white below; fur very soft; length 112 mm.; tail 50 mm.; hind foot 15 mm.: eastern Colorado and western Nebraska to Mexico.

*P. apache* Merr. Color rich buff; length 139 mm.; tail 67 mm.; hind foot 18 mm.: eastern Arizona, western New Mexico and southern Utah.

*P. panamintinus* Merr. Color grayish buff; underparts white; fur long and silky; length 143 mm.; tail 78 mm.; hind foot 20 mm.: southern California and Nevada.

*P. longimembris* (Coues). Color uniform, being buff above and white below; length 145 mm.; tail 74 mm.; hind foot 18 mm.: San Joaquin Valley; Sonoran zone.

*P. parvus* (Peale). Color gray or buff, having two color phases; length 171 mm.; tail 91 mm.; hind foot 22 mm.: central and southeastern Oregon, Washington, and the Great Basin; Upper Sonoran zone.

Fig. 176. *Perognathus penicillatus (after Stone & Cram).*

*Subspecies of P. parvus*

*P. p. parvus* (Peale). Yakima River, Washington to southeastern Oregon.

*P. p. mollipilosus* Coues. Size smaller, color darker: northeastern California to Klamath Basin.

*P. p. olivaceus* Merr. Color lighter: Great Basin from southern Idaho and Oregon to Owens Valley, California.

*P. p. magruderensis* Osgood. Size larger; length 198 mm.: southeastern California and Nevada.

*P. lordi* (Gray). Color pale buff; length 183 mm.; tail 97 mm.; hind foot 23 mm.: plains of the Columbia; Upper Sonoran and Transition zones.

*P. formosus* Merr. Color grizzled sepia; white below; length 189 mm.; tail 106 mm.; hind foot 24 mm.; tail very long, heavily crested: southern Nevada, Utah and California; Lower Sonoran zone.

*P. hispidus* Baird. Color ochraceous; under parts white; fur harsh but without bristles; soles of hind feet naked; length 222 mm.; tail 108 mm.; hind foot 26 mm.: Great Plains from the Dakotas to Mexico; westward to the base of the Rockies.

*P. penicillatus* Woodhouse (Fig. 176). Color buff; length 205 mm.; tail 100 mm.; hind foot 25 mm.; tail long and crested: southern California, Arizona and Nevada.

*P. intermedius* Merr. Color drab; fur harsh, with spines on the rump; length 179 mm.; tail 102 mm.; hind foot 22 mm.: southern Arizona, New Mexico and Texas.

*P. fallax* Merr. Color dark drab; length 192 mm.; hind foot 23 mm.: southern California.

*P. femoralis* Allen. Size very large; tail and ears very long; color dark drab; under parts dirty white; length 223 mm.; tail 126 mm.: hind foot 27 mm.: extreme southern California.

*P. californicus* Merr. Color dark drab; under parts yellowish white; rump and flanks supplied with bristles; length 192 mm.; tail 103 mm.; hind foot 24 mm.: central and southern California.

*Subspecies of P. californicus*

*P. c. californicus* Merr. Vicinity of San Francisco Bay.

*P. c. dispar* Osgood. Size larger; color paler: coast valleys of California; southward to San Bernardino.

*P. c. ochrus* Osgood. Color paler; length 200 mm.: Kern County, California.

**2. Perodipus** Fitzinger. Kangaroo rats (Fig. 177). Body slender; hind legs and tail very long, the tail black dorsally and ventrally and white on the sides and ending with a penicillate tuft; hind foot with 5 toes; fur soft; soles of feet hairy; dentition 1/1, 0/0, 0/0, 3/3; color brownish or yellowish, with a conspicuous white stripe across the thigh; eyes large: about 20 species, mostly in western America; burrowing, nocturnal animals with remarkable jumping powers, making jumps 4 to 6 feet long. They inhabit deserts and dry plains, feeding on seeds and leaves, and raise from 2 to 6 young in a litter.

FIG. 177.—*Perodipus agilis* (*after Stone & Cram*).

*P. simulans* Merriam. Color brown; length 285 mm.; tail 172 mm.: San Diego County, California.

*P. stephensi* Merr. Color dark clay; length 295 mm.; tail 180 mm.; hind foot 43 mm.: San Jacinto County, California.

*P. streatori* Merr. Color brown; size of *P. stephensi:* Mariposa County, California.

*P. venustus* Merr. Color dark yellowish brown; length 316 mm.; tail 191 mm.; hind foot 45 mm.: Santa Cruz County, California.

*P. sennetti* (Allen). Color yellowish buff; length 210 mm.; tail 110 mm.; hind foot 35 mm.: southeastern Texas.

*P. montanus* (Baird). Color yellowish brown, mixed with black; sides pale; length 250 mm.; tail 130 mm.; hind foot 40 mm.: western South Dakota to Texas; the Great Plains to the base of the Rockies.

*Subspecies of P. montanus*

*P. m. utahensis* Merr. Clay color; size larger: northern Utah.

*P. m. richardsoni* (Allen). Color ochraceous buff: Oklahoma.

*P. ordi* (Woodhouse). Clay color; tail brownish above; length 244 mm.; tail 140 mm.; hind foot 39 mm.: southern Texas.

*Subspecies of P. ordi*

*P. o. columbianus* Merr. Color darker: valley of the Columbia in western Oregon.

*P. agilis* (Gambel) (Fig. 177). Color yellowish brown, mixed with dusky; length 308 mm.; tail 182 mm.; hind foot 41 mm.: western California, south of Lake Tulare.

*P. cabezonæ* Merr. Color buffy ochraceous; length 282 mm.; tail 171 mm.; hind foot 42 mm.: deserts of southeastern California.

*P. goldmani* Merr. Color drab-brown; length 312 mm.; tail 185 mm.; hind foot 45 mm.: Salinas River Valley, California.

*P. ingens* Merr. Size very large; color buffy ochraceous; length 350 mm.; tail 190 mm.: Carriso Plain, Arizona.

*P. longipes* (Merr.). Color ochraceous buff; a large pure white spot over each eye and another behind each ear; length 275 mm.; tail 165 mm.; hind foot 42 mm.: Painted Desert, Arizona.

*P. microps* Merr. Color pale buff; length 270 mm.; tail 158 mm.; hind foot 40 mm.: Inyo County, California.

*P. morroensis* Merr. Color dark buff; length 292 mm.; tail 177 mm.; hind foot 44 mm.: San Luis Obispo County, California.

*P. panamintinus* Merr. Color buffy clay; length 301 mm.; tail 180 mm.; hind foot 44 mm.: Panamint Mountains, California.

*P. perplexus* Merr. Color yellowish-brown, mixed with dusky; length 320 mm.; tail 195 mm.; hind foot 46 mm.: southern Sierras and Tejon Mountains.

3. **Dipodomys** Gray. Similar to *Perodipus* in size and coloration, but with 4 toes on the hind foot: about 6 species in the United States.

*D. merriami* Mearns. Back clay color, darkest on the head; underparts silky white; length 241 mm.; tail 143 mm.; hind foot 33 mm.: California to Texas and southward into Mexico.

*Subspecies of D. merriami*

*D. m. merriami* Mearns. Southern Arizona to Texas.

*D. m. exilis* Merriam. Color darker: San Joaquin Valley, California.

*D. m. kernensis* Merr. Color pale buff: Kern County, California.

*D. m. mortivallis* Elliot. Color very pale: Death Valley, California.

*D. m. nevadensis* Merr. Color pale; tail shorter; hind foot longer: Washoe County, Nevada.

*D. m. nitratus* Merr. Color intense ochraceous: Inyo County, California.

*D. m. nitratoides* Merr. Dusky crescent over nose: Tulare County, California.

*D. californicus* Merr. Color dark sepia brown; tail long; length 302 mm.; 183 mm.; hind foot 43 mm.: northern California.

*D. deserti* Stephens. Color pale yellowish brown; mastoid region enormously inflated; length 322 mm.; tail 192 mm.; hind foot 48 mm.: southern California.

*D. elator* Merr. Back clay-color; length 290 mm.; tail 170 mm.; hind foot 45 mm.: northern Texas and southern Oklahoma.

*D. spectabilis* Merr. Color ochraceous buff; length 350 mm.; tail 211 mm.; hind foot 52 mm.: southern Arizona.

*D. parvus* Rhoads. Color buffy gray; tail-pencil sooty brown; length 248 mm.; tail 154 mm.; hind foot 35 mm.: southern California.

**4. Microdipodops** Merriam. Kangaroo mice. Size very small; penicillate, four-striped tail lacking; mastoid region very much inflated: 3 species.

*M. californicus* Merr. Color olivaceous; under parts snow white; length 160 mm.; tail 92 mm.; hind foot 25 mm.: southern California.

*M. pallidus* Merr. Color pale buff; tail with a dark tip; length 171 mm.; tail 102 mm.; hind foot 25 mm.: Churchill County, Nevada.

*M. megacephalus* Merr. Color yellowish brown; under parts white; tail bicolor; length 150 mm.; tail 80 mm.; hind foot 24 mm.: northern Nevada and southeastern Oregon.

**Family 4. Zapodidæ.**—Jumping mice. Small mouse-like rodents with very long hind legs and tail and short fore legs, which progress by leaping; ears and eyes large; upper incisors much curved, compressed and deeply sulcate: 2 genera and about 15 species, in the northern United States and Canada; 1 species in China.

**Key to the Genera of Zapodidæ**

$a_1$ One very small premolar present.....1. *Zapus.*
$a_2$ No premolars present.....2. *Napæozapus*

**1. Zapus** Coues. Tail longer than the rest of the body; hind foot nearly half as long as the head and body; dentition 1/1, 0/0, 1/0, 3/3; premolars very small: about 8 species, which live in meadows and make nests in burrows in the ground or in tufts of grass or hollow logs;

progress is made by leaps, which may be 10 feet in length; they hibernate in the winter; 1 or 2 litters annually of 5 or 6 young each.

### Key to the Species of Zapus

$a_1$ In the eastern and central States.....*Z. hudsonius.*
$a_2$ In the Rocky Mountains and Pacific States.
  $b_1$ Lower parts not much suffused with the color of the sides.
    $c_1$ Size large; length over 240 mm.
      $d_1$ Ear conspicuously bordered with whitish.....*Z. princeps.*
      $d_2$ Ear never conspicuously bordered with whitish.....*Z. trinotatus.*
    $c_2$ Size small; length under 230 mm.....*Z. montanus.*
      *Z. pacificus.*
  $b_2$ Lower parts much suffused with the color of the sides .....*Z. orarius.*

*Z. hudsonius* (Zimmermann). Meadow jumping-mouse. Body about the size of a house-mouse; color yellowish brown above, with a broad dark dorsal band; white beneath; tail tipped with brown and bicolor; feet white; length 209 mm.; tail 124 mm.; hind foot 30 mm.: eastern and central States; westward to the Rockies and Alaska.

#### *Subspecies of Z. hudsonius*

*Z. h. hudsonius* (Zimm.). Hudson Bay to New Jersey, and in the mountains to North Carolina; west to Iowa and Missouri and Alaska.

*Z. h. americanus* (Barton). Size small; length 191 mm.: from Raleigh, N. C. along the coastal plain to Connecticut.

*Z. h. campestris* Preble. Size large; length 222 mm.: Great Plains from Manitoba to Nebraska; westward to Colorado and Wyoming.

*Z. princeps* Allen. Color yellowish brown, with a broad dark dorsal band; length 245 mm.; tail 147 mm.; hind foot 32 mm.: Rocky Mountain region from New Mexico to Alberta.

#### *Subspecies of Z. princeps*

*Z. p. oregonus* Preble. Color lighter; length 250 mm.: Blue Mountains, Oregon.

*Z. trinotatus* Rhoads. Color dark ochraceous buff on the sides; dorsal band very distinct; length 248 mm.; tail 153 mm.; hind foot 33 mm.: British Columbia to Humboldt Bay.

#### *Subspecies of Z. trinotatus*

*Z. t. alleni* Elliot. Tip of tail often white: Sierras from Mount Shasta to Kern River.

*Z. montanus* Merriam. Color dark ochraceous buff; dorsal area sharply defined; tail sharply bicolor; length 228 mm.; tail 135 mm.; hind foot 31 mm.: Cascade Range in Oregon.

*Z. orarius* Preble. Color dark ochraceous, dorsal area and lower parts strongly suffused with the color of the sides; length 220 mm.; tail 127 mm.; hind foot 30 mm.: coast from Point Reyes to Mad River, California.

*Z. pacificus* Merr. Color similar to *Z. orarius;* length 225 mm.; tail 141 mm.; hind foot 31 mm.: southwestern Oregon and northern California.

**2. Napæozapus** Preble. Similar to *Zapus*, but without premolars: 1 species.

*N. insignis* (Miller) (Fig. 178). Color of sides yellowish buff; back dark; belly white; tip of tail white; length 238 mm.; tail 146 mm.; hind foot 31 mm.: Nova Scotia to Maryland; westward to Lake Superior; in deep forests, near streams.

FIG. 178.—*Napæozapus insignis (after Stone & Cram).*

*Subspecies of N. insignis*

*N. i. roanensis* (Preb.). Smaller and darker: Roan Mountain, North Carolina.

**Family 5. Erethizontidæ.**—Porcupines. Large, short-legged rodents with long, stiff spines or quills mingling with the coarse hair; feet plantigrade; dentition 1/1, 0/0, 1/1, 3/3; molars with long roots: 3 genera, of which 2 are tropical; habits arboreal and nocturnal.

**Erethizon** F. Cuvier. Tail short and thick and not prehensile; toes 4 in front, 5 behind: 2 species.

*E. dorsatum* (L.). Common porcupine; hedgehog. Color uniform blackish; quills tipped with white; length 900 mm.; tail 150 mm.; hind foot 90 mm.; quills 50 to 100 mm. long and mostly concealed by the fur; average weight 18 lbs.; maximum weight 40 lbs.: northeastern America; Lower Hudsonian, Canadian and Upper Ta nsition zones; westward to the Great Plains. Porcupines climb trees for bark and twigs, which they feed on, but they are clumsy climbers and live mostly on the ground, nesting in holes among the rocks; from 1 to 4 young raised annually; they do not hibernate.

*E. epixanthum* Brandt. Western porcupine. Similar to *E. dorsatum;* tips of long hairs greenish yellow; midventral line brownish; length 825 mm.; tail 165 mm.: from the upper Missouri into New Mexico; westward to the Pacific; northward from California to Alaska.

*Subspecies of E. epixanthum*

*E. e. couesi* Mearns. Smaller and paler: Arizona and New Mexico.

**Family 6. Aplodontiidæ.**—Mountain beavers; boomers. Form stout, heavy; limbs short; head broad, flat, triangular; tail short; eyes very small; feet plantigrade, 5-toed; dentition 1/1, 0/0, 2/1, 3/3: 1 genus.

**Aplodontia** Richardson. With the characters of the family: about 4 species; burrowing, mainly nocturnal, animals which live in colonies in dense wet forests, in which they construct numerous runways and tunnels, and feed on bark, leaves and twigs, laying up large stores for winter use; they raise 2 or 3 young annually and do not hibernate.

*A. major* Merriam. Color grizzled grayish brown; belly gray; whiskers black; length 375 mm.; tail 33 mm.; hind foot 62 mm.: Sierras in Placer County, California.

*Subspecies of A. major*

*A. m. rainieri* Merr. Color paler; whiskers white: Mount Rainier, Washington.

*A. rufa* (Rafinesque). Color umber; belly gray: whiskers white; length 340 mm.; hind foot 53 mm.: Cascades of the Columbia River.

*A. pacifica* Merr. Color fulvous brown; belly plumbeous; length 304 mm.; tail 22 mm.; hind foot 48 mm.: Yaquina Bay, Oregon.

*A. phea* Merr. Color uniform bister brown; length 330 mm.; tail 30 mm.; hind foot 55 mm.: Marin County, California.

**A.** *olympica* Merr. Similar to *A. rufa*, but darker and larger; length 350 mm.; tail 35 mm.; hind foot 55 mm.: Olympic Mountains, Washington.

**Family 7. Sciuridæ.**—Squirrels, marmots, etc. Arboreal or terrestrial rodents, with mostly long, bushy tails; skull with postorbital processes; molars rooted and with tubercular biting surfaces: 15 or 20 genera and about 250 species; cosmopolitan, except in the Australian region; about 9 genera and 90 species in the United States and Canada.

**Key to the United States Genera of Sciuridæ**

$a_1$ Sides of body without flying membrane.

$b_1$ Body slender and graceful; tail long.

$c_1$ Cheek-pouches absent; tail very long; squirrels... 1. *Sciurus.*
$c_2$ Cheek-pouches present; tail moderate.
$d_1$ Thumb with well-developed nail; chipmunks.
$e_1$ Premolars 1/1; eastern chipmunks ..... 2. *Tamias.*
$e_2$ Premolars 2/1; western chipmunks (Fig. 181) ..... 3. *Eutamias.*
$d_2$ Thumb with rudimentary nail (Fig. 182); ground squirrels.
$e_1$ Back broadly striped.
$f_1$ Head and neck with a golden mantle.... 4. *Callospermophilus.*
$f_2$ Head and neck colored like back..... 5. *Ammospermophilus.*
$e_2$ Back with narrow stripes or mottled or grizzled; gophers..... 6. *Citellus.*
$b_2$ Body stout and heavy; tail short; cheek-pouches shallow.
$c_1$ Color uniform; prairie dogs..... 7. *Cynomys.*
$c_2$ Color not uniform; woodchucks..... 8. *Marmota.*
$a_2$ Sides of body with furred membrane (flying squirrels)... 9. *Sciuropterus.*

**1. Sciurus** L. Body slender; tail long and bushy, the hairs being longest on the sides; ears and eyes large; thumb rudimentary; dentition 1/1, 0/0, 1/1 or 2/1, 3/3: over 100 species; cosmopolitan, excepting the Australian region; 10 species and numerous subspecies in the United States; about 30 species in Mexico and Central America; arboreal and mostly diurnal rodents which feed on seeds, nuts and buds, and often on young birds, bird-eggs and insects, and which build their nests in trees; they probably do not usually hibernate, and usually lay up stores of food.

**Key to the Species of Sciurus in the United States**

$a_1$ Upper premolars 2 in number, making 5 grinders on each side in upper jaw (Fig. 179).
$b_1$ Size small; hind foot less than 55 mm. long; color red.
$c_1$ In the eastern, central and Rocky Mountain States.
$d_1$ In the northeastern, north-central and Rocky Mountain States; common red squirrel..... *S. hudsonicus.*
$d_2$ In the central Rockies and southwestern States..... *S. fremonti.*
$c_2$ On the Pacific slope..... *S. douglasi.*
$b_2$ Size large; hind foot more than 60 mm. long; color gray, sometimes black.
$c_1$ Ears not tufted.
$d_1$ In the eastern and central States; common gray squirrel..... *S. carolinensis.*
$d_2$ On the Pacific slope..... *S. griseus.*
$c_2$ Ears tufted with long black hairs.
$d_1$ Belly white; ears black..... *S. aberti.*
$d_2$ Belly dark; ears reddish..... *S. kaibabensis.*

$a_2$ Upper premolar 1 in number, making 4 grinders on each side in upper jaw (Fig. 180).
$b_1$ In the eastern and central States; common fox squirrel.....*S. niger.*
$b_2$ In Arizona.....*S. apache.*
*S. arizonensis.*

*S. hudsonicus* Erxleben. Red squirrel. Color reddish brown above and whitish beneath; tail relatively narrow and short; ears tufted in winter; length 315 mm.; tail 130 mm.; hind foot 47 mm.: northern America from Labrador to Alaska and British Columbia; southward to Virginia and Tennessee; westward to Utah; several litters of young raised a year, from 4 to 6 each.

*Subspecies of S. hudsonicus*

*S. h. hudsonicus* Erx. Colors pale; fringe of tail yellowish: eastward of Rocky Mountains in Canadian and Hudsonian zones.

*S. h. gymnicus* Bangs. Size small; length 290 mm.; outer fringe of tail red; colors deep; belly gray in winter: northeastern States, Canadian zone; southward into New York State.

*S. h. loquax* Bangs. Outer fringe of tail yellowish; colors pale; belly pure white at all seasons: eastern States, Transition and Upper Austral zones.

*S. h. minnesota* Allen. Size large; colors pale; under side of tail gray; length 345 mm.: Minnesota to Iowa.

*S. h. dakotensis* Allen. Size large; colors very pale; center of tail yellowish red: Black Hills.

*S. h. baileyi* Allen. Fringe of tail black; dorsal band pale; size large: central Wyoming and eastern Montana.

*S. h. ventorum* Allen. End of tail black; size large: Yellowstone Park region into the Wasatch Mountains.

*S. h. richardsoni* Bachman. Upper surface of tail mostly black; size large: western Montana into eastern Washington and Oregon.

*S. h. streatori* Allen. Terminal third of tail black: Columbia River, northward into British Columbia.

*S. fremonti* Audubon & Bachman. Similar to *S. hudsonicus*, but larger; dorsal band pale yellowish rufous; length 335 mm.; tail 140 mm.; hind foot 55 mm.: Colorado, Utah, New Mexico and Arizona; Canadian zone.

*Subspecies of S. fremonti*

*S. f. fremonti* Aud. & Bach. Color grayish; white beneath: mountains of Colorado and northeastern Utah.

*S. f. lychnuchus* Stone & Rehn. Color dull ferruginous; fringe of tail black: White Mountains, New Mexico.

*S. f. neomexicanus* Allen. Size smaller: Taos Range, New Mexico.

*S. f. mogollonensis* Mearns. Dorsal band brighter: higher mountains of central Arizona; Canadian and Boreal zones.

*S. f. grahamensis* Allen. Like *S. f. mogollonensis*, but paler: fir zone, Graham Mountains, Arizona.

FIG. 179.—Skull of *Sciurus carolinensis* (*from Elliot*).

*S. douglasi* Bachman. Pine squirrel; redwood squirrel. Similar to the red squirrel; color brown or brownish gray above and buff or gray beneath; fur soft and dense; tail short, fringed with yellow; length 300 mm.; tail 110 mm.; hind foot 50 mm.: Pacific slope from British Columbia to Lower California; in coniferous forests.

*Subspecies of S. douglasi*

*S. d. douglasi* Bach. Washington and Oregon, along the coast.

*S. d. mollipilosus* Audubon & Bachman. Color dark brown; belly gray; white tail fringe: coast region of northern California and southern Oregon.

*S. d. cascadensis* Allen. Size large; tail fringe white: Cascade Mountains.

*S. d. albolimbatus* Allen. Tail fringe white; belly buff; size large: Sierras of northern California; southeastern Oregon.

*S. carolinensis* Gmelin. Gray squirrel (Fig. 179). Color gray above with a rusty middorsal region and white beneath; the melanistic color phase not uncommon in many localities; tail very long and bushy, edged with white; length 500 mm.; tail 220 mm.; hind foot 70 mm.: eastern and central States; westward into Oklahoma and Nebraska; 2 litters of from 4 to 6 young each are raised.

*Subspecies of S. carolinensis*

*S. c. carolinensis* Gmelin. Size smaller; length 455 mm.: Austral zone; southward to the northern part of the Gulf States; westward into Oklahoma and Nebraska.

*S. c. leucotis* Gapper. Transition and lower edge of Canadian zones; southward into the Pennsylvanian mountains; westward to Minnesota.

*S. c. hypophœus* Merriam. Size large; color dark; only a small white streak on the belly: Minnesota forest belt.

*S. c. extimus* Bangs. Size small; length 438 mm.; color light: southern Florida.

*S. c. fuliginosus* Bachman. Color blackish, grizzled with brown; brown beneath: the bayou region of Louisiana.

*S. griseus* Ord. Gray squirrel. Size large; color gray above and white beneath; length 590 mm.; tail 270 mm.; hind foot 80 mm.: Pacific slope.

*Subspecies of S. griseus*

*S. g. griseus* Ord. Southwestern Washington to Lower California; Transition zone and upper border of Austral, except the coast belt south of San Francisco.

*S. g. anthonyi* Mearns. Color gray, suffused with yellowish-brown: Laguna Mountains, southern California.

*S. g. nigripes* Bryant. Color much darker; upper surface of feet blackish: coast region south of San Francisco.

*S. aberti* Woodhouse. Color gray with a broad reddish dorsal band; white beneath, with a black or reddish line separating the gray from the white; ear long and pointed, terminating with a long black tuft; length 500 mm.; tail 220 mm.; hind foot 73 mm.: northeastern Arizona, New Mexico and Colorado; in coniferous forests; Transition zone.

*Subspecies of S. aberti*

*S. a. aberti* Wood. Mountains of northeastern Arizona and western New Mexico.

*S. a. ferreus* True. No reddish dorsal band: northern Colorado.

*S. a. mimus* Merr. Reddish dorsal band present: southwestern Colorado; northern New Mexico.

FIG. 180.—Skull of *Sciurus niger* (*from Elliot*).

*S. kaibabensis* Merr. Similar to *S. aberti;* belly black: region of the Grand Canyon, Arizona; 2 annual litters of 3 or 4 each.

*S. niger* L. Fox squirrel (Fig. 180). Color reddish brown above and rusty or rusty white beneath; rarely (in the south) black; tail long and bushy; length 590 mm.; tail 270 mm.; hind foot 73 mm.; weight 2 or 3 lbs.: eastern and central States; westward to the eastern border of the Great Plains; usually 1 litter a year of 2 to 4 young.

*Subspecies of S. niger*

*S. n. niger* L. Color more grayish varying to black; nose and ears white: southeastern States, east of the Alleghenies; north to Virginia.

*S. n. neglectus* (Gray). Color more reddish: southern New York and New England to central Virginia.

*S. n. rufiventer* Geoffrey. Size smaller; length 540 mm.; color deeper ferruginous: Mississippi Valley from the Alleghanies to the Great Plains; southward to northern Louisiana.

*S. n. texianus* Bachman. Size smaller; length 475 mm.; colors pale: coast region of Mississippi and Louisiana.

*S. apache* Allen. Color of the fox squirrel; upper surface with a broad dorsal band, which may be obscured in the summer; length 554 mm.; tail 279 mm.; hind foot 77 mm.: southern Arizona and Mexico; Transition zone.

*S. arizonensis* Coues. Color grizzled gray; belly white; tail black above, edged with white, brown beneath; length 540 mm.; tail 265 mm.; hind foot 71 mm.: central and southern Arizona.

**2. Tamias** Illiger. Chipmunks. Body small; tail short and not bushy; large internal cheek pouches present; dentition 1/1, 0/0, 1/1, 3/3: 1 species; terrestrial squirrels which make their nests in deep burrows in the ground, in which they hibernate a longer or shorter time in winter; stores of food layed up.

*T. striatus* (L.). Common chipmunk. Color reddish brown, with a middorsal black stripe and with 2 lateral whitish, longitudinal stripes, each bordered on each side by a black stripe; end of tail blackish; rump ferruginous; length 250 mm.; tail 90 mm.; hind foot 33 mm.: eastern and central States; Upper Austral and Transition zones; westward into Nebraska and Oklahoma; several litters of young a year, of 4 to 6 each; the food consists mainly of seeds and fruits, but also of insects, snails, young birds and birds eggs, and other small animals.

*Subspecies of T. striatus*

*T. s. striatus* (L.). Southeastern States.

*T. s. griseus* Mearns. Size larger; color less reddish: upper Mississippi Valley, westward of the Great Lakes; southward to eastern Kansas and Missouri.

*T. s. lysteri* (Richardson). Color pale and dull; rump yellowish brown: New England to Lake Huron; Upper Transition and Lower Canadian zones.

*T. s. venustus* Bangs. Upper surface dark gray; size large: Oklahoma.

**3. Eutamias** Trouessart. Western chipmunks. Similar to *Tamias*, but with 2 upper premolars; nail of thumb well developed: about 35 species and subspecies; in western America.

*E. dorsalis* (Baird) (Fig. 181). Color rusty gray with a dark brown dorsal stripe; other stripes faint; under parts grayish white; length 237 mm.; tail 105 mm.; hind foot 22 mm.: Utah to the Sierras; southward into New Mexico and Arizona.

*E. townsendi* (Bachman). Color dark yellowish brown with 5 black dorsal stripes; light stripes almost obsolete; tail black, fringed with white; belly white; length 257 mm.; tail 107 mm.; hind foot 35

FIG. 181.—Skull of *Eutamias dorsalis* (premolars and molars below, those of the upper jaw being at the left ) (*from Elliot*).

mm.: British Columbia to the Columbia River; from the coast to Lake Chelan; 1 annual litter, possibly more, of 2 to 6 each.

*E. hindsi* (Gray). Color reddish brown; under parts white; outer pair of dorsal stripes very light; length 264 mm.; tail 110 mm.; hind foot 34 mm.: coast region from San Francisco, northward.

*E. pricei* (Allen). Color grayish brown; beneath whitish; 5 black dorsal stripes and 4 ashy gray; length 252 mm.; tail 119 mm.; hind foot 35 mm.: coast region from San Francisco to San Diego.

*E. merriami* (Allen). Color pale yellowish gray; ears high, pointed; length 285 mm.; tail 117 mm.; hind foot 34 mm.: mountains of southern California.

*E. quadrimaculatus* (Gray). Color of head and rump gray, rest of back ferruginous; ears very large; length 249 mm.; tail 93 mm.; hind

foot 35 mm.: central California from Placer County to the Klamath Lakes.

*E. senex* (Allen). Color uniform gray; ears small; length 263 mm.; tail 114 mm.; hind foot 35 mm.: Yosemite Park to the Des Chutes River, Oregon.

*E. speciosus* (Allen). Like *E. merriami;* tip of tail black; length 234 mm.; tail 91 mm.; hind foot 32.: San Bernardino and San Jacinto Mountains, California.

*E. frater* (Allen). Color pale gray; tail deep orange; length 233 mm.; hind foot 32 mm.: western Nevada to central California.

*E. panamintinus* (Merr.). Color pale gray; facial stripes indistinct; length 208 mm.; tail 96 mm.; hind foot 31 mm.: west side of Great Basin in California and Nevada.

*E. amœnus* (Allen). Color gray; flanks ochraceous brown; belly white; length 207 mm.; tail 70 mm.; hind foot 30 mm.: Klamath Lakes to Lake Tahoe.

*E. caurinus* (Merr.). Similar to *E. amœnus*, but without white behind the ears: Olympic Mountains, Washington.

*E. cinereicollis* (Allen). Color gray; flanks yellowish brown; length 247 mm.; tail 102 mm.; hind foot 35 mm.: San Francisco and Mogollon Mountains, Arizona.

*E. umbrinus* (Allen). Color yellowish brown; outer dark stripes obsolete; length 249 mm.; tail 100 mm.; hind foot 32 mm.: Wasatch and Uinta Ranges, Utah.

*E. quadrivittatus* (Say). Color gray, yellowish on the sides: length 223 mm.; tail 82 mm.; hind foot 31 mm.: Michigan to Wyoming.

### *Subspecies of E quadrivittatus*

*E. q. animosus* Warren. Color paler: southeastern Colorado; Upper Sonoran zone.

*E. q. gracilis* (Allen). Body larger, more slender; tail longer: Transition zone, New Mexico and Arizona.

*E. q. luteiventris* (Allen). Colors bright; under parts buff; flanks ferruginous; size larger: Rockies in Montana.

*E. q. neglectus* (Allen). Colors bright; size large: northern Michigan to northern Minnesota; Canada.

*E. q. borealis* (Allen). Size small; colors yellower: Minnesota to Idaho; north to Alaska.

*E. minimus* (Bachman). Size small; color gray, rusty yellow on the flank; tail black above, yellowish below; length 200 mm.; tail 85 mm.:

hind foot 29 mm.: Bad Lands and plains of Dakota, Montana and Wyoming.

*Subspecies of E. minimus*

*E. m. caryi* Merr. Color paler and grayer: San Luis Valley, Colorado.

*E. m. consobrinus* (Allen). Size larger; colors darker: eastern border of the Great Basin in Utah, Colorado and New Mexico.

*E. m. pictus* (Allen). Colors pallid: Great Basin from western Utah westward; northward to eastern Washington.

*E. m. alpinus* (Merr.). Like *E. m. pictus*, but paler; tip of tail black; length 189 mm.: high Sierras, California.

*E. callipeplus* (Merr.). Top of head and nape drab; shoulders ochraceous; flanks fulvous; length 212 mm.; tail 91 mm.; hind foot 34 mm.: Mount Pinos to the Yosemite Valley, California.

*E. cooperi* (Baird). Color of anterior part of body grizzled gray; whitish beneath; 3 dorsal stripes distinct, other two less marked; length 150 mm.; tail 82 mm.: Cascade Mountains, Skamania County, Washington.

*E. pallidus* (Allen). Color ochraceous buff; length 220 mm.; tail 120 mm.; hind foot 35 mm.: South Dakota, Montana and western Nebraska.

**4. Callospermophilus** Merriam. Golden chipmunks; rock squirrels. Body heavy, with 1 white and 2 black stripes on each side; head, fore limbs and neck uniform reddish or yellowish brown; dentition 1/1, 0/0, 2/1, 3/3: about 8 species, in mountain States of the far-west, in forests of pine and fir; in feeding habits similar to chipmunks; they hibernate often from 5 to 7 months; a single litter of 4 to 7 young raised.

*C. lateralis* (Say). Color of back reddish brown; lateral stripe broad and bordered above and below by a black stripe; under parts pale brownish gray; length 275 mm.; tail 100 mm.; hind foot 43 mm.: Arizona and New Mexico into Utah and Colorado; Transition and Lower Boreal zones.

*Subspecies of C. lateralis*

*C. l. saturatus* (Rhoads). Size larger; length 317 mm.; colors darker: central Washington.

*C. l. chrysodeirus* (Merr.). Head, neck and shoulders ochraceous: Oregon, northern California and western Nevada.

*C. bernardinus* (Merr). Similar to *C. l. chrysodeirus;* color of head and shoulders duller; length 242 mm.; tail 77 mm.; hind foot 34 mm.: southern California.

*C. castanurus* (Merr.). Head and shoulders chestnut; length 284 mm.; tail 92 mm.; hind foot 43 mm.: Wasatch Mountains, Utah.

*C. cinerascens* (Merr.). Head and shoulders chestnut; color of back grizzled gray; length 322 mm.; tail 108 mm.; hind foot 44 mm.: Idaho, Montana and northwards.

*C. wortmani* (Allen). Color yellowish gray, mixed with black; neck and shoulders deep ochraceous; length 280 mm.; tail 95 mm.; hind foot 42 mm.: Wyoming and northwestern Colorado.

**5. Ammospermophilus** Merriam. Antelope chipmunks; ground squirrels. Size small; one whitish lateral stripe; tail very short and carried curved over the back; skull very broad; dentition 1/1, 0/0, 2/1, 3/3: 4 species, in arid plains; several litters of young raised a year, of from 4 to 12 each.

*A. leucurus* (Merr.). Color grizzled yellowish brown above and yellowish white beneath; tail grizzled blackish above and white below; length 209 mm.; tail 69 mm.; hind foot 38 mm.: southern California, and Arizona; Sonoran zone; in deserts.

*Subspecies of A. leucurus*

*A. l. cinnamomeus* (Merr.). Upper parts uniform pale cinnamon, lined with black: northern Arizona, southern Utah and Colorado.

*A. l. vinnulus* (Elliot). Color darker; under parts of body and tail white: mountains of southern California.

*A. harrisi* (Audubon & Bachman). Similar to *A. l. leucurus;* tail iron gray above and below; length 230 mm.; tail 80 mm.; hind foot 40 mm.: southern Utah and Nevada into Arizona and northwestern New Mexico.

*A. interpres* (Merr.). Similar to *A. leucurus*, but darker; tail bushy, with 2 free black bands; length 226 mm.; tail 80 mm.; hind foot 37 mm.: western Texas and eastern New Mexico.

*A. nelsoni* (Merr.). Color yellowish brown; under parts white; length 228 mm.; tail 68 mm.; hind foot 40 mm.: San Joaquin Valley, California.

**6. Citellus** Oken. (*Spermophilus* Cuvier). Ground squirrels; gophers. Small body and slender; cheek-pouches large; thumb rudimentary (Fig. 182); dentition 1/1, 0/0, 2/1, 3/3: about 80 species, mostly in the more or less arid regions of western America, northern Asia and Europe; about 15 species in the United States. Ground squirrels feed on grains, seeds, fruits, plants, etc. and are very destructive to crops; they also often eat insects and other small animals. They breed in deep bur-

rows, in which they raise from 5 to 13 young in a litter, and usually several litters a year. In the more northerly latitudes they hibernate in the winter, often 6 or more months, but in warmer regions may remain active throughout the year.

*C. tridecemlineatus* (Mitchill). Gopher. Color yellowish-brown, with about 6 yellowish longitudinal stripes alternating with rows of yellow spots, making about 13 stripes in all; belly yellowish; ears small; length 250 mm.; tail 87 mm.; hind foot 32 mm.: central States, from eastern Michigan to the Rockies; southward to northern Missouri and central Texas; northward into Saskatchewan; a single litter of young raised a year.

FIG. 182.—Fore foot of *Citellus spilosoma* (*from Mearns*).

*Subspecies of C. tridecemlineatus*

*C. t. tridecemlineatus* (Mitch.). Eastern Michigan to Dakota.

*C. t. alleni* (Merriam). Size small; colors dark: Bighorn Mountains, Wyoming.

*C. t. parvus* (Allen). Size small; length 204 mm.: western Colorado, Wyoming and Utah; Upper Sonoran zone.

*C. t. pallidus* (Allen). Size small; colors pale: Great Plains from northern Texas to eastern Montana and western Dakota.

*C. t. olivaceus* (Allen). Color dusky brown above: Black Hills.

*C. t. badius* (Bangs). Size large; length 276 mm.; colors dark: Missouri.

*C. t. texensis* (Merr.). Size large; color deep ferruginous: eastern Texas and Oklahoma.

*C. franklini* (Sabine). Body yellowish brown, speckled with black but not striped; tail with 3 black lines; length 375 mm.; tail 137 mm.; hind foot 50 mm.: central prairie region from Saskatchewan into Kansas; eastward to Indiana; 1 litter annually of 4 to 8 each.

*C. spilosoma* (Bennett). Color reddish brown with ill-defined spots arranged in longitudinal series; under parts yellowish white; ears very short; length 255 mm.; tail 75 mm.; hind foot 32 mm.: southern California to Texas.

*Subspecies of C. spilosoma*

*C. s. macrospilotus* (Merr.). Color dark; spots large and far apart; also with a drab-gray color phase: southern Arizona.

*C. s. major* (Merr.). Dorsal spots indistinct: eastern New Mexico and western Texas to Nebraska.

*C. s. pratensis* (Merr.). Size small; length 197 mm.; colors dark: northwestern Arizona.

*C. s. arens* (Bailey). Colors pale; spots small: southwestern Texas.

*C. s. annectans* (Merr.). Color grayish brown; spots buff: southern coast region of Texas.

*C. tereticaudus* (Baird). Color grizzled grayish brown, without spots; tail very long; length 248 mm.; tail 112 mm.; hind foot 35 mm.: central California to southern Arizona.

*C. neglectus* (Merr.). Like *C. tereticaudus* but with a much shorter tail; length 278 mm.; tail 74 mm.; hind foot 32 mm.: Arizona.

*C. cryptospilotus* (Merr.). Color pale buff, without spots; length 190 mm.; tail 60 mm.; hind foot 32 mm.: Painted Desert, Arizona.

*C. obsoletus* (Kennicott). Color light gray, spotted indistinctly; length 205 mm.; tail 50 mm.: Black Hills and western Nebraska; westward to Utah.

*C. elegans* (Kenn.). Color uniform dusky yellowish brown, without spots; length 311 mm.; tail 82 mm.; hind foot 46 mm.: Wyoming, northern Utah and northwestern Colorado; Transition and Upper Sonoran zones.

*C. armatus* (Kenn.). Color uniform dark gray, without spots; length 254 mm.; tail 50 mm.: Wyoming, Idaho and Montana.

*C. richardsoni* (Sab.). Similar to *C. elegans*, but paler: North Dakota and Montana; Canada.

*C. columbianus* (Ord.). Color yellowish brown, with many white blotches; length 370 mm.; tail 88 mm.; hind foot 44 mm.: western Montana to Washington.

*C. grammurus* (Say). Color mottled gray; length 530 mm.; tail 200 mm.; hind foot 60 mm.: central Colorado south into Mexico.

*Subspecies of C. grammurus*

*C. g. buckleyi* (Slack). Head and shoulders black; back grizzled black and white: western Texas.

*C. g. fisheri* (Merr.). Neck and shoulder with silvery stripes; whitish spots on the sides; length 415 mm.: central and southern California.

*C. g. beecheyi* (Richardson). Color yellowish brown; back indistinctly spotted; length 402 mm.: western California, north of San Francisco.

*C. g. douglasi* (Rich.). Like *C. g. beecheyi*, but with neck and shoulders black: northern California to the Columbia.

*C. g. utah* Merr. Size smaller; ears larger; back much redder: Wasatch Mountains, Utah.

*C. mollis* (Kenn.). Color dusky yellowish brown, without spots; ears rudimentary; length 208 mm.; tail 45 mm.: Utah and Nevada.

*Subspecies of C. mollis*

*C. m. stepheni* (Merr.). Head and shoulders pinkish buff: Nevada.

*C. m. canus* (Merr.). Color dusky grizzled gray: northern Oregon.

*C. m. yakimensis* (Merr.). Color buffy gray: eastern Washington.

*C. townsendi* (Bachman). Color dark reddish brown, speckled with white; ears very small; length 305 mm.; tail 90 mm.; hind foot 37 mm.: plains of the Columbia River to Montana.

*C. beldingi* (Merr.). Sides and under parts yellowish gray; dorsal band bright rufous; length 300 mm.; tail 89 mm.; hind foot 45 mm.: central California.

*C. chlorus* Elliot. Color olive gray above and grayish white below; ears very small, blackish; length 255 mm.; tail 100 mm.; hind foot 37 mm.: southern California.

*C. mohavensis* (Merr.). Color grizzled gray above, whitish beneath; length 230 mm.; tail 68 mm.; hind foot 38 mm.: Mojave Desert, California.

*C. mexicanus parvidens* (Mearns). Color olivaceous gray with about 9 obscure interrupted white stripes; belly white; length 325 mm.; tail 130 mm.; hind foot 44 mm.: valley of the lower Rio Grande and the Gulf coast northward to Corpus Christi.

**7. Cynomys** Rafinesque. Prairie dogs. Body stout; tail very short and flat; ears small; cheek-pouches shallow; skull strongly convex; dentition 1/1, 0/0, 2/1, 3/3; 5 toes on each foot, all with claws: about 5 species, inhabiting the more or less arid plains of the western States and Mexico. They are burrowing animals which live in colonies and feed on grasses and other plants, including grain, often to the great detriment of crops. They are not strictly hibernating animals, except during severe cold; a single litter of from 4 to 6 young is raised. The rattlesnake and burrow-owl are often found in their burrows, and feed on their young.

*C. ludovicianus* (Ord.). Color dark pinkish cinnamon above and whitish beneath; tail tipped with black; length 388 mm.; tail 86 mm.; hind foot 62 mm.: Great Plains from central Texas to central North Dakota; westward to the eastern base of the Rockies.

*Subspecies of C. ludovicianus*

*C. l. ludovicianus* (Ord.). Eastward to about the 97th meridian; westward to central Montana, Wyoming and Colorado; introduced into Iowa, Louisiana, South Carolina and Nantucket Island; chiefly Upper Sonoran, but also Transition and Lower Sonoran zones.

*C. l. arizonensis* Mearns. Colors brighter: southwestern Texas to southeastern Arizona.

*C. leucurus* Merriam. Color yellowish buff or grayish; terminal two-thirds of tail white; length 358 mm.; tail 57 mm.; hind foot 62 mm.: Wyoming and into northern Colorado and northeastern Utah; Transition zone.

*C. parvidens* Allen. Like *C. leucurus*, but smaller and reddish in color and less grayish; length 338 mm.; tail 43 mm.; hind foot 59 mm.: central Utah.

*C. gunnisoni* (Baird). Color as in *C. leucurus*; terminal half of tail with a gray center, bordered and tipped with white; length 340 mm.; tail 53 mm.; hind foot 56 mm.: central Colorado and north-central New Mexico; Transition zone, also Upper Sonoran and Canadian zones.

*Subspecies of C. gunnisoni*

*C. g. zuniensis* Hollister. Color more cinnamon and less buff; size larger: western Colorado, northern New Mexico and Arizona.

**8. Marmota** Blumenbach (*Arctomys* Schreber). Woodchucks; ground-hogs. Body large and heavy; tail short; legs short and stout; cheek pouches small; dentition 1/1, 0/0, 2/1, 3/3; skull nearly flat on top: about 10 species in northern America, Europe and Asia; 4 species in the United States. A woodchuck digs a deep burrow, usually in a field, which may extend 25 feet or more into the ground, in which it has its nest and hibernates in the winter. Its food consists of grasses, clover, etc.; a single litter of from 3 to 9 young is raised.

**Key to the American Species of Marmota**

$a_1$ Upper parts grizzled brownish, yellowish, drab or buff.
  $b_1$ Sides of neck without conspicuous buffy patches..... *M. monax.*
  $b_2$ Sides of neck with conspicuous buffy patches..... *M. flaviventris.*
$a_2$ Upper parts mainly black and white..... *M. caligata.*

*M. monax* (L.). Common woodchuck. Color grizzly gray, varied with chestnut, yellowish and black; under parts chestnut, length 573 mm.; tail 145 mm.; hind foot 83 mm.; weight about 9 lbs.: eastern and

northern America from Hudson Bay to Georgia; westward in the United States to eastern Kansas and in Canada to Alaska.

*Subspecies of M. monax*

*M. m. monax* (L.). Middle eastern States from New Jersey to western Iowa and eastern Oklahoma; southward to western North Carolina and northern Georgia and Alabama.

*M. m. preblorum* Howell. Colors paler; length 515 mm.: New England; northward to southern Maine and central Vermont.

*M. m. rufescens* How. Colors redder; length 548 mm.: New York State westward through Michigan to eastern North Dakota; western Massachusetts.

*M. m. canadensis* (Erxleben). Size small; colors strongly reddish; length 513 mm.: northern Michigan, Wisconsin, Minnesota and New England, and Canada; northwestward to Alaska.

*M. m. petrensis* How. Like *M. m. canadensis*, but with a larger skull: northern Idaho and Montana; British Columbia.

*M. flaviventris* (Audubon & Bachman). Yellow-bellied woodchuck. Color yellowish brown above, yellowish beneath; sides of neck with large buffy patches; length 600 mm.; tail 170 mm.; hind foot 85 mm.: Rocky Mountain and Pacific States.

*Subspecies of M. flaviventris*

*M. f. flaviventris* (Aud. & Bach.). The Cascade Range in Oregon and northern Sierras in California.

*M. f. sierræ* How. Colors redder: higher Sierras from Kern River to Mono Lake.

*M. f. avara* (Bangs). Colors paler; size smaller: eastern Oregon and Washington.

*M. f. parvula* How. Size smaller; colors like *M. f. sierræ* but paler: central Nevada.

*M. f. engelhardti* Allen. Size smaller; under parts darker: Utah and southern Idaho.

*M. f. nosophora* How. Colors more ochraceous above and redder below that *M. f. engelhardti:* mountain regions of Montana, Idaho and Wyoming.

*M. f. dacota* (Merriam). Color like *M. f. nosophora*, buffy above; size large; length 643 mm: Black Hills to Bridger Pass, Wyoming.

*M. f. luteola* How. Size large; under parts yellowish: mountains of northern Colorado and southern Wyoming.

*M. f. warreni* How. Size large; colors deep red with buff: western Colorado.

*M. f. obscura* How. Size large; color dark brown, mixed with white: northern New Mexico and southern Colorado.

*M. caligata* (Eschscholtz). Whistler. Color of fore part of back white, hinder and sides of body part cinnamon, mixed with black; under parts white; feet and top of head black; length 755 mm.; tail 250 mm.; hind foot 110 mm.: Alaska to Washington and Montana.

*Subspecies of M. caligata*

*M. c. nivaria* How. High mountains of northwestern Montana and northern Idaho.

*M. c. cascadensis* How. Head and feet browner and under parts darker: Cascade Range, Washington; southward to Mount Rainier.

*M. c. olympus* (Merr.). Color brownish drab; feet brown: upper slopes of Olympic Mountains.

**9. Sciuropterus** F. Cuvier. Flying squirrels. Small rodents with a broad furry membrane stretching between the front and hind legs and extending out from the sides; tail flattened; ears large; dentition 1 1, 0/0, 2/1, 3/3: about 15 species; in the northern hemisphere; 3 species in the United States, nocturnal animals which make their nests in holes in trees; from 2 to 6 young form a litter, of which there probably are several a year.

**Key to the Species of Sciuropterus**

$a_1$ In the eastern and central States.
  $b_1$ Belly pure white.....*S. volens.*
  $b_2$ Belly dirty white.....*S. sabrinus.*
$a_2$ In the Rocky Mountain and Pacific slope region.....*S. alpinus.*

*S. volans* (L.). Color drab above ringed with reddish; beneath pure white; length 230 mm.; tail 100 mm.; hind foot 37 mm.; fur soft and dense: eastern and central States from southern Maine to Florida; westward to the plains.

*Subspecies of S. volans*

*S. v. querceti* Bangs. Color more uniform russet: Gulf States from Georgia to Texas.

*S. sabrinus* (Shaw). Color drab above and dirty white beneath; length 280 mm.; tail 125 mm.; hind foot 42 mm.: northeastern and central States and Canada; southward into Massachusetts and northern New York; northwestward to Alaska.

*Subspecies of S. sabrinus*

*S. s. macrotis* Mearns. Color more reddish: northern New York and New England.

*S. s. silus* Bangs. Size small; length 214 mm.; color brown above: the higher southern Alleghanies.

*S. alpinus* (Richardson). Body large and yellowish brown in color; whitish beneath; length 309 mm.; tail 143 mm.; hind foot 40 mm.: the Rocky Mountains from the Mackensie River to Colorado, the Great Basin and the Pacific slope.

*Subspecies of S. alpinus*

*S. a. bangsi* Rhoads. Color olive brown: Idaho County, Idaho.

*S. a. olympicus* Elliot. Color blackish slate; length 346 mm.: Olympic Mountains, Washington.

*S. a. oregonensis* (Bachman). Colors dark; length 302 mm.: northern California to Alaska, in pine forests near the coast.

*S. a. fuliginosus* Rhoads. Color reddish brown; length 317 mm.: Cascade, Sierra Nevada and Coast Mountains.

*S. a. klamathensis* Merriam. Color brown tinged with fulvous: region of the Klamath Lakes.

*S. a. californicus* Rhoads. Color pale; length 286 mm.: San Bernadino Mountains, California.

*S. a. lascivus* Bangs. Color much darker than *S. a. californicus;* length 300 mm.: Eldorado County, California.

*S. a. stephensi* Merr. Like *S. a. klamathensis* but darker and smaller: Mendocino County, California.

**Family 8. Castoridæ.**—Beavers. Large, stout rodents with a large flattened and scaly tail; all feet with 4 toes; hind feet webbed and with a double-clawed second toe; dentition 1/1, 0/0, 1/1, 3/3: 1 genus.

**Castor** L. With the characters of the family: 1 American species.

*C. canadensis* Kuhl. Body covered with a dense, soft fur and dark brown in color; length 1,100 mm.; tail 410 mm.; hind foot 175 mm.; average weight 35 lbs.: North America from Hudson Bay and Alaska into the southern Alleghanies in the east and into Mexico in the west; exterminated in well-settled regions. Beavers are aquatic and nocturnal, and feed on bark and twigs. The nest is usually in a conical lodge built of sticks and mud in a pond formed by throwing a dam of sticks and earth across a stream. Along streams with high banks the nest is often a chamber in the bank above the water level, and con-

nected with the stream by a tunnel whose entrance is under the water. From 2 to 5 young are raised annually.

*Subspecies of C. canadensis*

*C. c. canadensis* Kuhl. Northeastern and central America; Hudsonian, Canadian and Transition zones.

*C. c. carolinensis* Rhoads. Size larger; color lighter; tail broader: North Carolina to Louisiana.

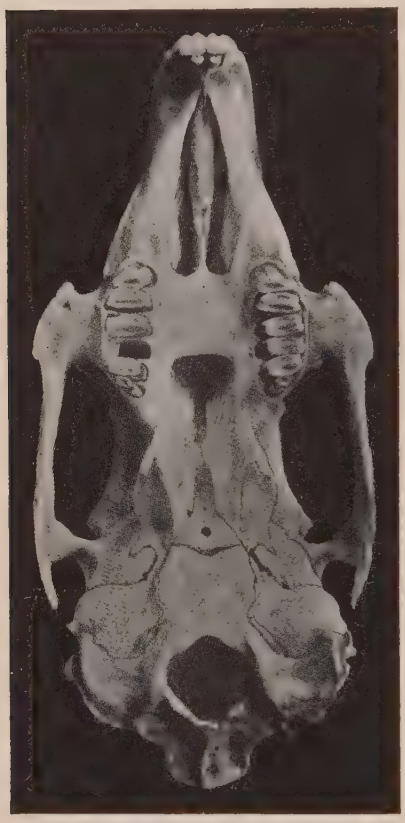


FIG. 183.—Skull of *Lepus* (*from Elliot*).

*C. c. frondator* Mearns. Color lighter; russet brown above: Montana to Mexico.

*C. c. pacificus* Rhoads. Size large; length 1143 mm.; color reddish chestnut: Pacific slope from California to Alaska.

*C. c. subauratus* Taylor. Size very large; length 1171 mm.; color hazel and gray with a golden sheen: San Joaquin County, California.

**Family 9. Leporidæ.**—Rabbits and hares. Large rodents with 4 upper incisors (Fig. 183), a large pair in front and a small pair immediately behind them; upper lip divided; front legs short, with 5 toes; hind legs very long and with 4 toes; tail rudimentary; ears very long; dentition 2/1, 0/0, 3/2, 3/3: 5 genera and about 70 species, found throughout the world; 3 genera and 16 species in the United States. The American rabbits and hares (with the exception of *Brachylagus idahoensis*) do not burrow as do their European relatives, but frequently make their nests in holes in the ground.

**Key to the Genera of Leporidæ**

$a_1$ Size large; hind foot over 125 mm. long.....1. *Lepus.*
$a_2$ Size small; hind foot about 90 mm. long.....2. *Sylvilagus.*
$a_3$ Size very small; hind foot about 70 mm. long.....3. *Brachylagus.*

**1. Lepus** L. Size large; ears and hind legs very long; no interparietal bone in the adult; third to fifth ribs broad and flattened: circumpolar; 15 species in America, 7 in the United States; the young, when born, are well furred and have their eyes open.

**Key to the Species of Lepus**

$a_1$ In the eastern States.....*L. americanus.*
$a_2$ In the States west of the Mississippi.
  $b_1$ Tail pure white.....*L. campestris.*
  $b_2$ Tail not pure white, but with black on top.
    $c_1$ Color white in winter, there being 2 annual moults; ear proportionally short and broad, the length not being over 85 mm.
      $d_1$ In western Washington.....*L. washingtoni.*
      $d_2$ In the Rockies.....*L. bairdi.*
    $c_2$ Color in winter similar to that in summer, there being 1 annual moult; ear over 125 mm. long.
      $d_1$ Color of flanks similar to that of belly, and sharply different from that of back.....*L. alleni.*
      $d_2$ Color of flanks similar to that of back.....*L. californicus.*

*L. americanus* Erxleben. White rabbit; varying hare; snowshoe rabbit. Color grayish or reddish brown in summer and white in winter; length 470 mm.; tail 43 mm.; hind foot 133 mm.: northern America from Berings Strait to the Atlantic; southward to British Columbia, central Minnesota and Michigan; throughout New England and New York and in the mountains into Virginia; mainly the Canadian zone, in swamps and wet thickets; from 2 to 7 young in a litter.

*Subspecies of L. americanus*

*L. a. americanus* Erx. Color in summer pale tawny brown; borders of ears conspicuously white: Hudson Bay to northern Quebec and Ontario, and in Michigan to Saganaw Bay; westward to the Canadian Rockies.

*L. a. virginianus* Harlan. Color in summer bright rusty brown; borders of ears whitish; length 518 mm.: New England south of the Penobscot; New York and southward into the mountains of Virginia and West Virginia, also in Maryland, Delaware and New Jersey.

*L. a. struthopus* Bangs. Color in summer dull tawny brown; length 474 mm.: Maine east of the Penobscot and eastward into Newfoundland; Canadian zone.

*L. a. phæonotus* Allen. Color in summer dull yellowish buff; length 464 mm.: northern Minnesota and Wisconsin and western half of the northern peninsula of Michigan; Canadian zone.

*L. washingtoni* Baird. Color in summer dull dark rusty brown; in winter similar, but slightly paler; length 429 mm.; tail 41 mm.; hind foot 125 mm.: Washington from the Cascades to the sea; Canadian and Transition zones.

*L. w. klamathensis* Merriam. Colors paler: Klamath Lake region to central eastern California; Canadian zone.

*L. bairdi* Hayden. Color in summer dusky grayish or rusty brown; in winter pure white; length 459 mm.; tail 39 mm.; hind foot 146 mm.: Rocky Mountains from Washington, Idaho and Montana to New Mexico; Canadian and Hudsonian zones.

*L. alleni* Mearns. Antelope jack rabbit. Size large; ears and legs very long; color of top of back yellowish brown; sides, rump and shoulders gray; under parts pure white; base of tail black; length 606 mm.; tail 63 mm.; hind foot 131: deserts of southern Arizona and Mexico.

*L. campestris* Bachman. White-tailed jack rabbit. Color in summer pale yellowish gray; entire tail white; tip of ear black; in winter pure white; length 605 mm.; tail 92 mm.; hind foot 149 mm.: northern and western States from Wisconsin to eastern California. The jack rabbits weigh about 6 pounds and are remarkable for their speed, clearing 20 feet at a leap. They feed on bark, leaves and herbage and as they often do very great damage to crops are much hunted for purpose of extermination, and also for the fur and meat.

*Subspecies of L. campestris*

*L. c. campestris* Bach. Great Plains from Wisconsin to the Rockies; northward into Canada; southward to New Mexico and southern Kansas.

*L. c. townsendi* Bach. Color uniform gray, without any yellowish: Great Basin; eastward to the summit of the Rockies.

*L. c. sierræ* Merr. Size large; color uniform gray; length 635 mm.: high Sierras from Mount Shasta to Mount Whitney.

*L. californicus* Gray. Black-tailed jack rabbit. Color dark ochraceous brown or dark buffy brown in winter and paler in summer; under parts dull dark buff; top of tail black; length 604 mm.; tail 95 mm.; hind foot 131 mm.: Nebraska and Texas to the Pacific; northward to Washington; southward into Mexico; 1 to 6 young in a litter.

*Subspecies of L. californicus*

*L. c. californicus* Gray. Coast of California from Cape Mendocino to Graviota Pass; eastward to the Sierras; northward in the interior to the Willamette.

*L. c. deserticola* Mearns. Colors very pale, being ashy gray above; length 542 mm.: Great Basin from southeastern California and Nevada to central Arizona and Utah; northward into Idaho.

*L. c. wallawalla* Merr. Like *L. c. deserticola* but darker, more pinkish: northeastern California and northwestern Nevada and northward to Washington.

*L. c. richardsoni* Bach. Color light yellowish buff: San Joaquin Valley, California.

*L. c. bennetti* Gray. Color paler, more grayish; length 556 mm.: coast of California from Graviota Pass into Lower California.

*L. c. eremicus* Allen. Color much paler, dull grayish: southern Arizona, east of Phœnix; Mexico.

*L. c. texianus* Waterhouse. Color pale gray: western Texas, New Mexico, northeastern Arizona and southwestern Colorado; Mexico.

*L. c. merriami* Mearns. Color dark buffy brown: southern Texas from the Trinity River to the Rio Grande; Mexico.

*L. c. melanotis* Mearns. Color bright ochraceous buff: Great Plains from eastern South Dakota to Oklahoma and northern Texas and westward to the Rockies.

**2. Sylvilagus** Gray. The cottontails. Size moderate; interparietal bone distinct; anterior ribs narrow and rod-like; ears and legs relatively short: about 15 species, about 9 in the United States, the others in Mexico; the young, when born, are blind and naked.

**Key to the United States Species of Sylvilagus**

$a_1$ Tail comparatively large and loosely haired and cottony-white beneath; feet well haired.
  $b_1$ In States east of the Mississippi.
    $c_1$ Color gray ..... *S. floridanus.*
    $c_2$ Color pinkish buff; black patch between the ears ..... *S. transitionalis.*
  $b_2$ In States west of the Mississippi.
    $c_1$ Ear between 50 mm. and 60 mm. long.
      $d_1$ Color gray ..... *S. floridanus.*
      $d_2$ Color buff, in the Rockies and Great Basin ..... *S. nuttalli.*
    $c_2$ Ear more than 65 mm. long ..... *S. auduboni.*
$a_2$ Tail comparatively short, densely haired; white or gray beneath.
  $b_1$ In the coastal belt of the Pacific coast ..... *S. bachmani.*
  $b_2$ In the coastal belt of the south Atlantic coast ..... *S. palustris.*
  $b_3$ In the south-central States ..... *S. aquaticus.*

*S. floridanus* (Allen) (*Lepus sylvaticus* Bachman). Common rabbit; gray rabbit; cottontail. Color dark gray or rusty brown; tail white beneath; length 436 mm.; tail 45 mm.; hind foot 90 mm.: eastern

and central States and southern Canada; several litters of from 2 to 6 each are raised annually.

*Subspecies of S. floridanus*

*S. f. floridanus* (Allen). Peninsular Florida.

*S. f. mallurus* (Thomas). Size larger; upper parts darker, more reddish: Atlantic States from Long Island and the lower Hudson Valley into Florida east of the Alleghanies.

*S. f. mearnsi* (Allen). Length 446 mm.; upper parts paler, more pinkish-buff; ears shorter: central States from the Alleghanies to eastern Nebraska; southward from Kentucky to eastern Kansas; northward from southern New York to southern Minnesota.

*S. f. similis* Nelson. Color pale buffy gray; length 408 mm.: eastern North and South Dakota, Nebraska, northern Kansas and Colorado.

*S. f. alacer* (Bangs). Color dark pinkish buff; length 418 mm.: southern and Gulf States from Georgia to Oklahoma; northward to central Missouri and Kansas; westward to central Texas.

*S. f. chapmani* (Allen). Color grayish brown without any rusty; length 403 mm.: middle and southern Texas; Mexico.

*S. f. holzneri* (Mearns). Color pale buffy gray: southern Arizona.

*S. f. cognatus* (Nel.). Size large; length 458 mm.; color light buffy gray: high mountains of central New Mexico.

*S. transitionalis* (Bangs). Common rabbit. Color uniform rich pinkish buff or yellowish brown with a distinct black spot between the ears; length 388 mm.; tail 39 mm.; hind foot 95 mm.: New England States; northward to Rutland, Vermont, and southwestern Maine; eastern New York south of Lake George, and along the Alleghanies into Georgia; mainly Transition zone.

*S. nuttalli* (Bach.). Color dark buffy brown; length 352 mm.; tail 44 mm.; hind foot 89 mm.: Rocky Mountain and Great Basin region.

*Subspecies of S. nuttalli*

*S. n. nuttalli* (Bach.). Eastern Washington and Oregon and western Idaho, northeastern California and northwestern Nevada.

*S. n. grangeri* (Allen). Size larger; color buffy gray: Nevada and Utah, except the southern portions, southern Idaho and Wyoming and Montana.

*S. n. pinetis* (Allen). Darker than *S. c. grangeri;* length 386 mm.: pine forests from central Arizona through northern New Mexico and Colorado.

*S. auduboni* (Baird). Color dark buffy brown; white beneath; length 418 mm.; tail 72 mm.; hind foot 86 mm.: western, southwestern and Rocky Mountain States; 2 to 7 young in a litter.

*Subspecies of S. auduboni*

*S. a. auduboni* (Baird). Interior of north-central California, including the region of San Francisco Bay.

*S. a. vallicola* Nel. Color pale yellowish brown; length 402 mm.; tail 55 mm.; hind foot 91 mm.: central-interior California; Lower Sonoran zone.

*S. a. sanctidiegi* (Miller). Size small; colors pale: coast region of southwestern California.

*S. a. arizonæ* (Allen). Color very pale; ears very large: deserts of southern California and Nevada and southwestern Arizona.

*S. a. minor* (Mearns). Size small; color pale grayish: southern New Mexico and Mexico.

*S. a. cedrophilus* Nel. Color dark buff: central New Mexico and Arizona.

*S. a. warreni* Nel. Color buffy brown: southwestern Colorado, northwestern New Mexico, northeastern Arizona and southeastern Utah.

*S. a. baileyi* (Merr.). Color uniform pale creamy buff; length 411 mm.: plains of eastern Montana, Wyoming and Colorado and western North Dakota into western Kansas.

*S. a. neomexicanus* Nel. Color dark buffy gray, slightly rusty: southern Kansas into central Texas and eastern New Mexico.

*S. a. parvulus* (Allen). Color yellowish gray: southern Texas and Mexico.

*S. bachmani* (Waterhouse). Brush rabbit. Size small; ears, tail and legs short; color dark grayish brown with a tinge of reddish; length 328 mm.; tail 31 mm.; hind foot 74 mm.: a narrow belt along the coast or near it from the Columbia River to Cape St. Lucas; Transition and Upper and Lower Sonoran zones.

*Subspecies of S. bachmani*

*S. b. bachmani* (Water.). Coastal region from Monterey to Santa Monica; also western foothills of the Sierras.

*S. b. ubericolor* (Miller). Color darker and more reddish: coastal region from Monterey Bay to the Columbia River; also the head of the Sacramento Valley.

*S. b. cinerascens* (Allen). Color lighter grayish brown: coastal region from Lower California to Santa Monica, also western side of the San Joaquin Valley.

*S. palustris* (Bach.). Marsh rabbit; pontoon. Body rather large and yellowish or reddish brown in color; beneath gray; legs short; length 436 mm.; tail 33 mm.; hind foot 91 mm.; under side of tail gray, sometimes brownish: coastal portions of the southern States from Dismal Swamp to Mobile Bay; in swampy woods; habits aquatic, the animals taking very readily to water and swimming well.

*Subspecies of S. palustris*

*S. p. paludicola* (Miller & Bangs). Color dark reddish brown: peninsular Florida.

*S. aquaticus* (Bach.). Swamp rabbit; cane-cutter. Color grayish brown; under side of tail pure white; length 534 mm.; tail 69 mm.; hind foot 106: river bottoms from western Georgia to central Texas and Oklahoma; northward to Tennessee and central Arkansas and in the Mississippi and Ohio River bottoms to Illinois.

*Subspecies of S. aquaticus*

*S. a. littoralis* Nel. Color much darker and reddish: narrow coast belt from Mississippi to Matagorda Bay, Texas.

**3. Brachylagus** Miller. Size small; ears short; tail very small and nearly unicolor: 1 species.

*B. idahoensis* (Merriam). Color drab or pinkish drab in winter and hair very long and soft; color in summer brownish gray; length 291 mm.; tail 18 mm.; hind foot 71 mm.: sagebrush plains of southern Idaho and Oregon and northern and central Nevada; makes its own burrows in the ground, being the only American rabbit or hare to do so.

**Family 10. Ochotonidæ.**—Conies; pikas. Small compact rodents with short legs and without external tail; skull depressed; molars rootless; clavicles well developed: about 26 species, in Europe, Asia and America.

**Ochotona** Link. Dentition $\frac{1}{1}, \frac{0}{0}, \frac{2}{2}, \frac{3}{3}$: about 7 species in the United States, which live in the high western mountains from Alaska to New Mexico, mainly above timber line, feeding upon herbage, of which they collect large winter stores; they do not hibernate; a single litter of from 2 to 4 young raised annually.

*O. albatus* Grinnell. Color hoary white above and white beneath; length 180 mm.; tail vertebræ 10 mm.; hind foot 29 mm.: Inyo County, California.

*O. saxatilis* Bangs. Color pale yellowish brown, buff beneath; length 182 mm.; hind foot 30 mm.: Snowy Range, Colorado.

*O. uinta* Hollister. Color uniform clay, without gray; size similar to *O. saxatilis:* Uinta Mountains, Utah.

*O. levis* Holl. Color light buffy brown; length 168 mm.; tail 10 mm.: Belt Mountains, Bitter Root Mountains, Montana.

*O. taylori* Grinnell. Color and size like *O. schisticeps*, but darker and browner: Modoc County, California.

*O. schisticeps* (Merriam). Color gray suffused with fulvous; top of head slate-gray; length 188 mm.; tail vertebræ 9 mm.; hind foot 29 mm.: Sierra Nevada Mountains, California.

*O. cinnamomea* Allen. Color pale cinnamon rufous, darker in the middorsal region; top of head gray; similar to *O. schisticeps*, but smaller and lacking the slate-gray area on the head: Beaver Range, Utah, above 10,000 feet elevation.

**Order 9. Ungulata.**—Hoofed animals. Mammals of large size with 1 to 4 hoofs on each foot; molar teeth with broad crowns and adapted to the mastication of grasses and grains: about a dozen families, grouped in 2 suborders, and distributed throughout the world except in the Australian region, of which 4 occur in North America and 2 in the United States and Canada. The order contains the most important domestic animals.

**Key to the Suborders of Ungulata**

$a_1$ Number of hoofs on each foot either 2 or 4; even-toed ungulates. 1. *Artiodactyla.*
$a_2$ Number of hoofs on each foot 1 or 3; odd-toed ungulates; no native species in the United States; horses; tapirs; rhinoceroses. 2. *Perissodactyla.*

**Suborder Artiodactyla.**—Even-toes ungulates. Third and fourth digits prolonged beyond the others and support the animal's body; premolar and molar teeth usually not alike; stomach complex: about 300 species grouped in 2 divisions; about 40 species in the United States and Canada.

**Key to the Divisions of Artiodactyla**

$a_1$ Upper incisors and canines presents. 1. *Suina.*
$a_2$ Upper incisors and canines absent. 2. *Ruminantia.*

**Division 1. Suina.**—Pigs. Non-ruminant *Artiodactyla* with incisor, canine, premolar and molar teeth in both jaws; no horns present; metacarpals and metatarsals not fused; body large and robust; hairs bristle-like; skin very thick: 3 families, 1 of which only has native

representatives in the United States, the other two families being the *Hippopotamidæ* and the *Suidæ*.

**Family Tayassuidæ.**—Peccaries. Small pigs with 3 toes on the hind feet and 4 toes on the fore feet; large musk gland in the middle of the rump; dentition 2/3, 1/1, 3/3, 3/3: 2 American genera.

**Pecari** Reichenbach. With the characters of the family: about 4 species, in Mexico, Central and South America.

*P. angulatus* (Cope). Collared peccary; muskhog. Color mixed black and white above, black predominating on the face and mane and back; white band over the shoulders to the middle of the back; under parts, nose and hoofs black; length 960 mm.; tail 60 mm.; weight 75 lbs.: southwestern Texas and into New Mexico and Mexico; gregarious animals, omnivorous in feeding habits, which are found in dense forests and also among scattered thickets on sandy plains; number of young 1.

**Division 2. Ruminantia.**—Ruminant *Artiodactyla* with, in most species, no incisors or canines in the upper jaw; metacarpals and metatarsals, in most species (all American), fused to form the single "cannonbone;" horns present in very many species; stomach complex, being divided into 4 compartments, the ruminating habit of the animals consisting in the swallowing of the food first into the capacious first compartment or paunch; its return to the mouth for further mastication (the chewing of the cud), and the second swallowing of it into the other three compartments, where it is digested: 2 subdivisions and 3 families in this country.

**Key to the Subdivisions of Ruminantia**

$a_1$ Horns of solid bone which are shed periodically; deer..... 1. *Cervina.*
$a_2$ Horns hollow and composed of horn and usually not shed; cattle; antelopes..... 2. *Cavicornia.*

**1. Cervina.** Deer. The males, and in the reindeers the females also, possess solid bone antlers which are shed every spring: 1 family.

**Family Cervidæ.**—With the characters of the subdivision: about 60 species, which are found in all the geographical regions except the Australian and African. The animals occur chiefly in forest regions and on grassy plains where they live on herbs, leaves, buds and young bark; about 25 species in the United States and Canada, grouped in 4 genera.

**Key to the Genera of Cervidæ**

$a_1$ Antlers cylindrical and not palmate.
  $b_1$ Antlers directed backwards, the prongs forwards..... 1. *Cervus.*
  $b_2$ Antlers directed forwards, the prongs upwards..... 2. *Odocoileus.*

$a_2$ Antlers more or less palmate.
  $b_1$ Males only with horns; lowest prongs not extending over the face ..... 3. *Alces.*
  $b_2$ Both sexes with horns; lowest prongs extending over the face. 4. *Rangifer.*

**1. Cervus** L. Antlers present only in the male, cylindrical, the first prong being just above the base and projecting over the brow; dentition 0/4, 1/0, 3/3, 3/3; tail very short; hoofs broad and rounded; nose naked; fawns spotted: 1 species.

*C. canadensis* Erxleben. Wapiti; elk. Color dark chestnut brown on the head, neck and under parts; back and sides yellowish gray; a large whitish patch on the rump; length 2,590 mm.; tail 140 mm.; hind foot 650 mm.; height at shoulders 1,220 mm.; weight about 700 lbs.; length of antlers along outside curve 1,655 mm.: Rocky Mountain region from New Mexico and Arizona to British Columbia; formerly eastward in the Canadian, Transitional and Upper Austral zones to the Atlantic; related to the red deer of Europe, *C. elephus* L.

*Subspecies of C. canadensis*

*C. c. occidentalis* Hamilton Smith. Size larger; head, legs and neck black: coastal forests from British Columbia into northwestern California.

*C. c. merriami* Nelson. Color yellowish brown: White Mountains, Arizona; nearly extinct.

*C. c. nannodes* Merriam. Color pale buffy gray; length 2030 mm.; tail 140 mm.; hind foot 620 mm.; legs short: Kern County, California.

**2. Odocoileus** Rafinesque. Antlers present in the male alone, the first prong being directed upwards and not over the brow; dentition 0/4, 0/0, 3/3, 3/3; tail rather long, thickly haired beneath; hoofs narrow; young spotted: about 20 species, 7 in the United States and Canada.

**Key to the United States Species of Odocoileus**

$a_1$ East of the Great Plains.
  $b_1$ Eastern States, north of the Gulf States ..... *O. americanus.*
  $b_2$ Gulf States ..... *O. osceola.*
$a_2$ Great Plains to the Pacific.
  $b_1$ In the Rio Grande region ..... *O. texanus.*
  $b_2$ In New Mexico and Arizona ..... *O. crooki.*
    *O. couesi.*
  $b_3$ Texas to Dakota and westwards ..... *O. hemionus.*
  $b_4$ On the Pacific slope ..... *O. columbianus.*

*O. americanus* (Erxleben) (*O. virginianus* Boddært). Virginia deer; white-tailed deer (Fig. 184). Color reddish chestnut in summer and grayish in winter; tail white beneath; length 1,800 mm.; tail 280 mm.; hind-foot 520 mm.; height at shoulder 925 mm.; length of antlers, outer curve, 600 mm.; average weight of buck 200 lbs.; extreme weight 400 lbs.: eastern and central States; common in many forest regions,

FIG. 37—Typical Tails.

1. Whitetail.
2. Mule-deer.
3. Coast Blacktail.

FIG. 184.—The tail (upper surface) of 1, *Odocoileus americanus;* 2, *O. hemionus;* 3, *O. columbianus* (*from Seton*).

where it feeds on grasses, leaves, buds, small shrubs, acorns, etc.; pairing time in the fall; fawns, usually 2 in number, born in May.

### *Subspecies of O. americanus*

*O. a. americanus* (Erx.). Eastern States from Ontario to Florida and Louisiana; westward to the Missouri River; Austral zone.

*O. a. borealis* Miller. Size larger; color gray in winter: eastern States and Canada; Canadian zone.

*O. a. macrourus* (Rafinesque). Size smaller; color paler: the Great Plains; westward to the Rockies, and to Oregon and Washington.

*O. a. louisianæ* G. M. Allen. Size large; length 2,000 mm.; color pale; antlers high and heavy: lowlands of Louisiana.

*O. osceola* (Bangs). Florida white-tail. Color dark brown above; flanks cinnamon; under parts white; length 1,600 mm.; tail 280 mm.: Gulf States; westward into Louisiana.

*O. texanus* (Mearns). Texas white-tail. Color pale yellowish white; black line from crown to tail; under parts white; ear with black edge;

length 1,585 mm.; tail 265 mm.; height at shoulder 880 mm.: southwestern Texas and Mexico.

*O. crooki* (Mearns). Crook's black-tail deer. Color reddish fawn; tail long, flattened, black above and white beneath; length 1,440 mm.; tail 195 mm.; height at shoulder 650 mm.: mountains of western New Mexico and of Arizona.

*O. couesi* (Coues & Yarrow). Arizona white-tail. Color pale fawn or gray above; sides tawny or brownish; tail white beneath; size small; height at shoulder 812 mm.; ear without black edge: southwestern New Mexico and southern Arizona.

*O. hemionus* (Raf.). Mule deer (Fig. 184). Color dull yellowish or tawny in the summer and gray in the winter, with a dark brown patch on the forehead; rump and tail white, the latter with a black tip; body heavy; ears very long; length 1,950 mm.; tail 205 mm.; height at shoulder 1,000 mm.; average weight 200 lbs.; length of antler along the curve 600 mm.: mountains and high plateaus of the west from North Dakota to Texas and into Mexico; westward into Washington, Oregon and California; number of young at a birth 2 or 3.

*Subspecies of O. hemionus*

*O. h. californicus* (Caton). Size large; a dark middorsal stripe present: Coast Range south of San Francisco.

*O. h. canus* Merriam. Smaller and paler: southwestern Texas, New Mexico and Arizona.

*O. h. eremicus* (Mearns). Size large; color very pale: head of the Gulf of California.

*O. columbianus* (Richardson). Black-tail deer (Fig. 184). Color brownish gray, darkest on the back; tail black above, white beneath; body stocky; ears large; length 1,780 mm.; tail 190 mm.; height at shoulders 863 mm.: coastal forests from Alaska to central California.

**3. Alces** Jardine. Moose. Size very large; antlers borne by the male alone and broadly palmate with numerous prongs projecting upwards; muzzle very broad, with a very convex contour; upper lip long and prehensile; legs very long; shoulders higher than the hips; tail very small; dentition 0/4, 0/0, 3/3, 3/3: 3 species, circumpolar; 2 species in America.

*A. americanus* Jard. Color black above, dark reddish brown on the sides; gray beneath; legs below the knees gray; a mane of stiff hairs on the neck; a pendent brush of hair called the "bell" on the throat; length 2,190 mm.; tail 280 mm.; height at shoulders 1,800 mm.; weight 800–1,200 lbs.: forests of North America from northern Maine and New

Brunswick to northern Michigan and North Dakota; northward to Hudson Bay and Alaska; in the Rockies into Montana and Idaho; a near relative of the European elk, *A. alces*.

**4. Rangifer** H. Smith. Antlers large and borne by both sexes, palmate near the tips; one or both brow-prongs palmate and extending over the face; dentition 0/4, 0/0, 3/3, 3/3; legs and tail short: 12 species, 1 in Asia and Europe, the reindeer *R. tarandus* (L.), and 11 in northern America which range throughout the Canadian, Hudsonian and Arctic zones; 2 species in the United States.

*R. caribou* (Gmelin). Woodland caribou. Color dark brown, sometimes reddish, on the back, head, sides and outsides of legs; under parts, rump and a band around each foot pure white; in winter, neck white, body gray; length 1,800 mm.; weight 280 lbs.; height at shoulders 1,000 mm.: forests of northern Maine and New Brunswick; northward to Great Slave Lake and Hudson Bay; much less gregareous than the Barren-ground caribou (*R. arcticus* Richardson), which ranges over the Arctic barrens to beyond the Arctic Circle.

*R. montanus* Seton. Color dark brown; under parts grayish white; length 2,413 mm.; tail 177 mm.; height at shoulders 1,397 mm.: Rocky Mountain region from Alaska into Idaho.

**2. Cavicornia.** Ruminants with hollow horns, composed of horn, in both sexes, which are never shed, except in *Antilocapra:* 2 families.

**Key to the Families of Cavicornia**

$a_1$ Horns branched..... 1. *Antilocapridæ.*
$a_2$ Horns not branched..... 2. *Bovidæ.*

**Family 1. Antilocapridæ.** Antelopes with erect horns, each with a short branch in front, which are shed each summer; ears long and pointed; lateral hoofs absent, digits 3 and 4 only present; dentition 0/4, 0/0, 3/3, 3/3: 1 genus.

**Antilocapra** Ord. With the characters of the family: 1 species.

*A. americana* (Ord.). Prong-horn antelope. Color light yellowish brown; under parts, rump, sides of head and spot behind ears white; length 1,350 mm.; tail 178 mm.; height at shoulder 850 mm.; weight 125 lbs.; length of horns 250 mm.: Great Plains from the Saskatchewan into Mexico; westward to the Rockies and into eastern Oregon and northeastern California; number of young at a birth usually 2.

**Family 2. Bovidæ.**—Cattle; sheep; goats; antelopes. Ruminants with unbranched horns, in most cases in both sexes, which are not shed; lateral hoofs usually present: numerous species, mostly in Asia and

Africa; about 10 species in America, including the buffalo, mountain sheep, mountain goats and muskox.

**Key to the United States Genera of Bovidæ**

$a_1$ Body very large and stout; nose not hairy; buffalo.....1. *Bison.*
$a_2$ Body smaller; nose hairy; sheep and goats.
  $b_1$ Horns compressed anteroposteriorly; sheep.....2. *Ovis.*
  $b_2$ Horns compressed laterally; goats.....3. *Oreamnos.*

**1. Bison** H. Smith. Head large; shoulders high; hind quarters low and weak; fore quarters covered to the knees with a shaggy mane; horns thick at the base and curved; hoofs broad; tail long; dentition 0/4, 0/0, 3/3, 3/3: 1 species.

*B. americanus* (L.). Buffalo. Color dark brown, lighter on the rump; hoofs, nose and horns black; length 3,300 mm.; tail 500 mm.; height at shoulder 1,700 mm.; weight 1,800 lbs.: North America, formerly between the Alleghanies and the Rockies north of the Mexican Boundary, now extinct, except a few preserved herds in the Yellowstone Park and elsewhere, and a few wild herds in northern Canada.

**2. Ovis** L. Sheep. Body stout; legs short; nose narrow and hairy, except a small naked space between the nostrils; horns very large and heavy, curving backward and then downward; dentition 0/4, 0/0, 3/3, 3/3: numerous species in all continents except Australia and South America; about 7 species in northern America, 6 in the United States.

*O. canadensis* Shaw. Mountain sheep; bighorn. Color grayish brown, lighter in winter; large white rump patch; length 1,350 mm.; height at shoulders 1,000 mm.; length of horn 1,250 mm. in the male, curving outwards and forming often a circle; horns in female short and straight: high mountains from the Mexican boundary into British Columbia; number of young at a birth 1 or 2.

*Subspecies of O. canadensis*

*O. c. auduboni* Merriam. Size large; skull and horn massive: Bad Lands, South Dakota.

*O. c. gaillardi* Mearns. Size small; color ecru drab; feet very small: low desert ranges in the Austral zone south of the Gila River, Arizona.

*O. c. sierræ* Grinnell. Like *O. nelsoni*, but much paler; length 1,450 mm.; tail 120 mm.; hind foot 375 mm.: southern California.

*O. c. texiana* Bailey. Color dull buffy brown; rump patch pure white; length 1,530 mm.: Guadaloupe Mountains, Texas.

*O. nelsoni* Merr. Color pale brown; rump patch white; length 1,280 mm.; tail 100 mm.; hind foot 360 mm.; height at shoulder 830

mm.: desert mountain ranges of southern California, Nevada and Mexico.

*O. mexicana* Merr. Color drab brown, not so dark as *O. canadensis;* rump patch broad and squarely truncate; ears very long and large; length 1,530 mm.; tail 130 mm.; height at shoulder 900 mm.; hind foot 425 mm.: mountains of Texas, New Mexico and Arizona.

**3. Oreamnos** Rafinesque. Body stout; legs short; horns small, curving slightly backwards; chin with a beard; nose hairy; hair long: 2 species in northern America, 1 in Alaska.

*O. montanus* (Ord.). Mountain goat. Color yellowish white; horns and hoofs black; length 1,200 mm.; tail 250 mm.; height at shoulder 900 mm.; length of horns 250 mm.: high Rockies and Cascades to Alaska; number of young at a birth 1 or 2.

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Baur, George (1859–1898). German-American herpetologist and zoologist; professor in Clark and Chicago.

Bean, Tarleton H. (1846–1916). American ichthyologist; State Fish culturist, New York.

Beardslee, Lester A. (1836–1903). American naval officer and naturalist.

Beauvois, Palisat (1755–1820). French naturalist who traveled in America.

Bell, Thomas (1792–1880). English zoologist; professor in London.

Bendire, Charles E. (1836–1897). American ornithologist and army officer.

Bennett, Edward T. (1797–1866). American educator and scientist; professor in Cincinnati.

Bibron, G. French zoologist; professor in Paris.

Blainville, Marie Henri (1778–1850). French zoologist; professor in Paris.

Blanchard, Frank N. (1888– ). American herpetologist; instructor in University of Michigan.

Blatchley, Willis S. (1859– ). American naturalist; former State geologist of Indiana.

Bloch, Marcus (1723–1799). German ichthylogist and physician in Karlsbad.

Blumenbach Johannes (1752–1840). German zoologist and naturalist; professor in Göttingen.

Boitard, Pierre (1787–1859). French naturalist.

Bonaparte, Charles Lucian (1803–1857). French zoologist, nephew of Napoleon; lived in Philadelphia from 1822 to 1828.

Borkhausen, Matthies (1760–1806). German entomologist and naturalist in Darmstadt.

Boulenger, George Albert (1858– ). Belgian-English herpetologist; British Museum.

Brandt, Johann (1802–1879). Russian zoologist; professor in Petrograd.

Brauer, August. German zoologist; professor in Berlin.

Brayton, A. W. (1848– ). American naturalist and physician in Indianapolis.

Brevoort, James C. (1818–1887). American naturalist.

Brimley, Clement S. (1863– ). British-American naturalist; Raleigh, N. C.

Brisson, Mathurin (1723–1806). French ornithologist; professor in Paris.

Brown, Arthur E. (1850–1910). American herpetologist and mammalogist; Academy of Natural Sciences, Philadelphia.

Bryant, Edwin (1805–1869). American traveller and Californian pioneer.

Camp, Charles L. (1893– ). American herpetologist; American Museum of Natural History, New York.

Caton, John D. (1812–1895). American naturalist and lawyer in Chicago.

Chapman, Frank M. (1864– ). American ornithologist; American Museum of Natural History, New York.

Clark, H. Walton (1870– ). American zoologist; Biological Station, Fairport, Iowa.

Clark, Hubert Lyman (1870– ). American zoologist; Museum of Comparative Zoology, Harvard.

Clinton, Dewit (1769–1828). Governor of New York; builder of the Erie Canal.

Cope, Edward Drinker (1840–1897). American zoologist and paleontologist; professor in Haverford College and the University of Pennsylvania.

Copeland, Edwin N. (1873– ). American botanist; professor in Manila.

Coues, Elliott (1842–1899). American ornithologist and army surgeon.

Creaser, Charles W. (1897– ). American zoologist; Museum of Zoology, University of Michigan.

Cuvier, Ferdinand (1773–1838). French zoologist; professor in Paris: brother of Georges Cuvier.

Cuvier, Georges (1769–1832). French zoologist, paleontologist and comparative anatomist; professor in Paris.

Daudin, Francois (1774–1804). French zoologist.

Dekay, James E. (1782–1851). American naturalist and physician; Oyster Bay, Long Island.

Desmarest, Anselm (1784–1838). French zoologist; professor in Aalfort.

Dickerson, Mary C. (1866– ). American herpetologist; New York.

Ditmars, Raymond L. (1876– ). American herpetologist; New York Zoological Park, New York.

Dixon, Joseph S. (1884– ). American mammalogist; University of California Museum.

Dumeril, André (1774–1860). French physician and naturalist; professor in Paris.

Dunn, Emmett Reid (1894– ). American herpetologist; professor in Smith College.

Dybowski, Benedict (1834– ). Polish zoologist; professor in Lemberg.

Eigenmann, Carl H. (1863– ). German-American ichthyologist; professor in Indiana State University

Elliot, Daniel G. (1835–1915). American mammalogist; Field Columbian Museum, Chicago.

Ellis, Max M. (1887– ). American zoologist; professor in University of Missouri.

Erxleben, Johann (1744–1777). German naturalist; professor in Göttingen.

Eschscholt, Johann (1793–1831). Esthonian zoologist and physician; professor in Dorpat.

Evermann, Barton Warren (1853– ). American ichthyologist; director of the Museum of the California Academy of Sciences, San Francisco.

Fabricius, Johann Christian (1745–1808). Danish zoologist; professor in Kiel.

FISCHER, GOTTHELF (1771–1853). German zoologist; professor in Moscow.

FITZINGER, LEOPOLD (1802–1884). Austrian zoologist; Vienna.

FLEMMING, JOHN (1785–1857). Scotch zoologist; professor in Edinburg.

FORBES, STEPHEN A. (1844– ). American zoologist; professor in the University of Illinois.

FOWLER, HENRY W. (1878– ). American zoologist and naturalist; Academy of Natural Sciences, Philadelphia.

GAGE, SIMON HENRY (1851– ). American anatomist and naturalist; professor in Cornell.

GAIGE, HELEN THOMPSON (1889– ). American herpetologist; University of Michigan.

GAIRDNER, WILLIAM T. (1824–1907). English physician and naturalist; professor in Glasgow.

GAMBEL, WILLIAM. American physician and naturalist in Philadelphia.

GARDEN, ALEXANDER (1730–1791). American naturalist and physician in Charleston, S. C.

GARMAN, SAMUEL (1846– ). American zoologist and ichthyologist; Museum of Comparative Zoology, Harvard.

GEOFFROY SAINT-HILAIRE, ÉTIENNE (1772–1844). French zoologist; professor in Paris.

GERVAIS, PAUL (1816–1879). French zoologist and paleontologist; professor in Paris.

GIBBES, ROBERT W. (1809–1866). American naturalist and physician in Charleston, S. C.

GIBBONS, JAMES S. (1810–1892). American naturalist and banker in San Francisco.

GIGLIOLI, HENRI (1844–1909). Italian naturalist.

GILBERT, CHARLES H. (1859– ). American ichthyologist; professor in Stanford.

GILL, THEODORE N. (1837–1914). American zoologist and ichthyologist; professor in Washington.

GILLIAMS, JACOB (1784–1868). American physician in Philadelphia.

GIRARD, CHARLES (1822–1895). French-American zoologist; Smithsonian Institution.

GMELIN, JOHANN (1748–1804). German naturalist; professor in Göttingen; editor of 13th edition of Systema Naturæ.

GOLDMAN, EDWARD A. (1873– ). American zoologist and naturalist; United States Biological Survey.

GOODE, GEORGE BROWN (1851–1896). American ichthyologist; United States National Museum, Washington.

GRAVENHORST, JOHANN (1777–1857). German zoologist; professor in Breslau.

GRAY, GEORGE ROBERT (1808–1872). English naturalist; British Museum.

GRAY, JOHN EDWARD (1800–1881). English naturalist; British Museum; brother of George.

GREEN, WYMAN R. (1881– ). American zoologist; professor in Chattanooga.

GREENE, CHARLES W. (1866– ). American physiologist; professor in the University of Missouri.

GRIFFITH, ROBERT E. (1798–1850). American naturalist and physician in Philadelphia.

GRINNELL, JOSEPH (1877– ). American zoologist; professor in California.

GÜLDENSTÆDT, ANTON (1745–1781). Russian naturalist; professor in Petrograd.

GÜNTHER, A. K. (1830–1914). German-English ichthyologist and zoologist; British Museum.

HÆCKEL, ERNST (1834–1918). German zoologist; professor in Jena.

HALDEMAN, SAMUEL S. (1812–1880). American naturalist; professor in the University of Pennsylvania.

HARLAN, RICHARD (1796–1843). American naturalist and physician in Philadelphia.

HAY, OLIVER P. (1846– ). American naturalist and paleontologist; Carnegie Institution of Washington.

HAYDEN, FERDINAND V. (1829–1887). American geologist and naturalist; United States Geological Survey.

HECKEL, JOHANN (1790–1857). Austrian ichthyologist.

HENSHAW, SAMUEL. American zoologist; Museum of Comparative Zoology, Harvard.

HERRICK, CLARENCE L. (1858–1904). American zoologist; president of the University of New Mexico.

HOLBROOK, JOHN E. (1794–1871). American ichthyologist and herpetologist; professor in South Carolina College.

HOLLISTER, Ned (1876– ). American mammalogist; Zoological Park, Washington.

HORNADAY, WILLIAM T. (1854– ). American naturalist; director of the New York Zoological Park.

HOWELL, ARTHUR H. (1872– ). American mammalogist and ornithologist; United States Biological Survey, Washington.

HUBBS, CARL L. (1894– ). American ichthyologist; Zoological Museum, University of Michigan.

HUXLEY, THOMAS HENRY (1825–1895). English zoologist and naturalist; professor in London.

ILLIGER, JOHANNES (1775–1815). German zoologist; director Zoological Garden, Berlin.

JACKSON, HARTLEY H. T. (1881– ). American naturalist; United States Biological Survey, Washington.

JARDINE, WILLIAM (1800–1874). Scotch zoologist.

JENKINS, OLIVER P. (1850– ). American ichthyologist; Stanford University.

JORDAN, DAVID STARR (1851– ). American ichthyologist and naturalist; Stanford University.

KAUP, JOHANN JACOB (1803–1873). German naturalist in Darmstadt.

KENDALL, WILLIAM C. (1861– ). American ichthyologist; United States Fish Commission.

KERR, ROBERT (1750–1814). Scotch surgeon and naturalist in Edinburg.

KIRTLAND, JARED P. (1793–1877). American naturalist and physician; professor in Cleveland.

KUHL, HEINRICH (1797–1821). German naturalist.

LACÉPÈDE, ÈTIENNE (1756–1825). French zoologist; professor in Paris.

LAMARACK, JEAN (1744–1829). French zoologist, botanist and evolutionary philosopher.

LATREILLE, PIERRE (1762–1833). French zoologist and entomologist; professor in Paris.

LATROBE, BENJAMIN H. (1764–1820). American naturalist in Philadelphia.

LAURENTI, JOSEPH. Austrian herpetologist and physician in Vienna; latter half of 18th century.

LEACH, WILLIAM E. (1790–1836). English zoologist; British Museum.

LECONTE, JOHN EATON (1784–1860). American naturalist and army engineer; brother to Lewis.

LECONTE, JOHN LAWRENCE (1825–1883). American entomologist and physician in Philadelphia; a son of John E.

LECONTE, JOSEPH (1823–1901). American geologist; professor in the University of California; a son of Lewis.

LECONTE, LEWIS (1782–1838). American naturalist and physician; brother to John Eaton.

LESUEUR, CHARLES ALEXANDER (1794–1857). French zoologist who lived in Philadelphia from 1817 to 1825.

Leuckart, Friedrich Sigismund (1794–1843). German zoologist; professor in Freiburg; uncle of Rudolf.

Leuckart, Rudolf (1822–1898). German zoologist; professor in Leipzig; nephew of Friedrich.

Leunis, Johannes (1802–1873). German zoologist; professor in Hildesheim.

Lichtenstein, Martin (1780–1857). German zoologist; professor in Berlin.

Linck, Johannes (1674–1734). German zoologist; professor in Leipzig.

Linnæus, Carolus (1707–1778). Swedish naturalist; professor in Upsala.

Lord, John K. (1818–1872). English zoologist.

Matthes, Francois E. (1874– ). Dutch-American geologist and naturalist; United States Geological Survey.

McMurtrie, Henry (1793–1865). American educator and physician in Philadelphia.

Mearns, Edgar A. (1856–1916). American naturalist and army surgeon.

Meek, Seth E. (1859–1914). American ichthyologist and herpetologist; Field Columbian Museum, Chicago.

Merrem, Blasius (1761–1824). German naturalist; professor in Marburg.

Merriam, C. Hart (1855– ). American naturalist, formerly chief of the Biological Survey; Smithsonian Institution.

Miller, Gerrit S., Jr. (1869– ). American mammalogist; United States National Museum.

Mitchill, Samuel L. (1764–1831). American ichthyologist and naturalist, and physician in Philadelphia.

Monkhaus, William J. (1871– ). American physiologist and naturalist; professor in Indiana State University.

Moore, J. Percy (1869– ). American zoologist; professor in the University of Pennsylvania.

Morse, Max W. (1880– ). American physiologist; professor in the University of West Virginia.

Müller, Johannes (1801–1858). German anatomist and physiologist; professor in Berlin.

Murphy, Robert Cushman (1887– ). American ornithologist and naturalist; American Museum of Natural History, New York.

Nelson, Edward W. (1855– ). American naturalist; chief of the United States Biological Survey.

Nilsson, Sven (1787–1883). Swedish zoologist; professor in Lund.

Oken, Lorenz (1779–1851). German zoologist; professor in Munich.

Ord, Edward O. C. (1818–1883). American soldier and naturalist.

Osgood, Wilfred H. (1875– ). American mammalogist; Field Columbian Museum, Chicago.

Pallas, Peter Simon (1741–1811). German zoologist who lived long in Russia.

Palmer, T. Chalkley (1860– ). American naturalist and manufacturer in Philadelphia.

Palmer, Theodore S. (1868– ). American zoologist; United States Department of Agriculture.

Paulmeier, Frederic P. (1873–1906). American zoologist; State Museum, Albany.

Peale, Rembrandt (1778–1860). American naturalist and portrait painter in Philadelphia and Baltimore.

Pearse, Arthur S. (1877– ). American zoologist; professor in the University of Wisconsin.

Peters, Wilhelm (1815–1883). German traveller and zoologist; professor in Berlin.

Pickering, Charles (1805–1878). American naturalist on the Wilkes Exploring Expedition.

Pœy, Felipe (1799–1891). Cuban naturalist and ichthyologist; professor in Havana.

POWERS, JOSEPH H. (1866– ). American zoologist; University of Nebraska.

PRATT, HENRY S. (1859– ). American zoologist; professor in Haverford College, Pa.

PREBLE, EDWARD A. (1871– ). American mammalogist and ornithologist; United States Department of Agriculture, Washington.

PUTMAN, FREDERIC W. (1839–1915). American naturalist and anthropologist; professor in Harvard.

RAFINESQUE, CONSTANTINE (1784–1842). French-American naturalist; Lexington, Kentucky, and Philadelphia.

REESE, ALBERT M. (1872– ). American zoologist; professor in the University of West Virginia.

REHN, JAMES A. G. (1881– ). American mammalogist; Academy of Natural Sciences, Philadelphia.

REICHENBACH, HEINRICH (1793–1879). German zoologist and botanist; professor in Dresden.

REIGHARD, JACOB (1861– ). American zoologist; professor in the University of Michigan.

RHOADS, SAMUEL N. (1862– ). American naturalist, Philadelphia.

RICHARDSON, JOHN (1787–1865). Scotch naturalist and traveller in Arctic America.

RITTER, WILLIAM E. (1856– ). American zoologist; professor in the University of California.

RUTHVEN, ALEXANDER G. (1882– ). American herpetologist; professor in the University of Michigan.

SABINE, EDWARD (1788– ). English naturalist and Arctic traveller.

SAY, THOMAS (1787–1834). American zoologist; Academy of Natural Sciences, Philadelphia.

SCHLEGEL, HERMANN (1804–1884). German zoologist.

SCHNEIDER, JOHANN (1750–1822). German zoologist; professor in Breslau.

SCHŒPFF, JOHANN (1752–1800). German zoologist and physician in Ansbach.

SCHRANCK, FRANZ (1747–1835). German botanist and zoologist; professor in Munich

SCHREBER, JOHANN (1739–1810). German zoologist; professor in Erlangen.

SCHWEIGGER, AUGUST (1783–1821). German naturalist; professor in Königsberg.

SEALE, ALVIN (1873– ). American ichthyologist; Museum of Comparative Zoology, Harvard.

SETON, ERNEST THOMPSON (1860– ). Canadian naturalist; Greenwich, Conn.

SHAW, WILLIAM T. (1873– ). American zoologist; professor in Washington State College, Pullman.

SHUFELDT, ROBERT W. (1850– ). American ornithologist and army surgeon.

SHULL, A. FRANKLIN (1881– ). American zoologist; professor in the University of Michigan.

SLACK, JAMES. American naturalist and physician in Philadelphia.

SMITH, HAMILTON. English army officer and zoologist.

SMITH, HUGH M. (1865– ). American ichthyologist; United States Commissioner of Fisheries.

SNYDER, JOHN O. (1867– ). American ichthyologist; professor in Stanford University.

SPIX, JOHANN (1781–1826). German naturalist and traveller.

STEJNEGER, LEONHARD (1851– ). Norwegian-American herpetologist and naturalist; United States National Museum, Washington.

STONE, WITMER (1866– ). American zoologist; Academy of Natural Sciences, Philadelphia.

STORER, TRACY I. (1889– ). American zoologist and naturalist; Museum of the University of California.

STORR, GOTTLIEB (1749–1821). German zoologist; professor in Tübingen.

SUCKLEY, GEORGE (1830–1869). American traveller, naturalist and physician in New York.

SURFACE, HARVEY A. (1867– ). American zoologist; professor in Pennsylvania State College.

SWAIN, JOSEPH (1857– ). American ichthyologist; emeritus president of Swarthmore College.

SWARTH, HARRY S. (1878– ). American ornithologist and mammalogist; Museum of the University of California.

SWENK, MYRON H. (1883– ). American zoologist; professor in Nebraska.

TAYLOR, WALTER P. (1888– ). American zoologist and mammalogist; United States Biological Survey.

THOMAS, CYRUS (1825–1910). American naturalist and ethnologist.

THOMPSON, ZADOC (1796–1856). American naturalist; professor in the University of Vermont.

TROSCHEL, FRANZ (1810–1882). German zoologist; professor in Bonn.

TROUSSART, EDOUARD LOUIS (1842– ). French zoologist; professor in Paris.

TRUE, FREDERIC W. (1858–1914). American zoologist; United States National Museum, Washington.

TSCHUDI, JOHANN JACOB (1818–1889). Swiss zoologist and traveller.

TURTON, WILLIAM (1762–1835). English naturalist and physician in Swansea.

VALENCIENNES, ACHILLE (1794–1863). French zoologist; professor in Paris.

VAN DENBRUGH, JOHN (1872– ). American herpetologist; California Academy of Sciences, San Francisco.

VIGORS, NICHOLAS (1783–1840). Irish ornithologist and naturalist; British Museum.

VOIGT, JOHANN (1725–1810). German physician and naturalist.

WAGLER, JOHANN (1800–1832). German herpetologist; professor in Munich.

WAGNER, JOHANN (1797–1861). German zoologist; professor in Munich.

WALBAUM, JOHANN. German zoologist; latter part of 18th century.

WARREN, EDWARD R. (1860– ). American zoologist; Colorado Springs, Colorado.

WATERHOUSE, GEORGE R. (1810–1888). English naturalist.

WHIPPLE, INEZ L. (Mrs. H. H. Wilder) (1871– ). American zoologist; professor in Smith College.

WIED, MAXMILIAN (1782–1867). German naturalist and traveller in North and South America.

WIEGMANN, AREND (1802–1841). German zoologist; professor in Berlin.

WILDER, HARRIS H. (1864– ). American zoologist and anthropologist; professor in Smith College.

WILSON, ALEXANDER (1766–1813). Scotch-American ornithologist and naturalist; Philadelphia.

WOODHOUSE, SAMUEL W. American naturalist and army surgeon.

WRIGHT, ALBERT HAZEN (1879– ). American herpetologist; professor in Cornell.

YARROW, HARRY C. (1840– ). American herpetologist and physician in ashington.

W. ZIMMERMAN, EBERHARD (1743–1815). German zoologist and geographer.

# GLOSSARY OF TECHNICAL WORDS AND TERMS

**Abdomen.** The belly; the ventral portion of the posterior region of the trunk.

**Abdominal.** Pertaining to the abdomen; applied to the ventral fins of a fish when they are posterior in position.

**Abortive.** Incomplete; undeveloped.

**Acrodont teeth.** Teeth which are situated along the edge of the jaw bone.

**Acuminate.** Tapering to a point.

**Acute.** Sharp-pointed.

**Adipose.** Fatty; thick.

**Adipose fin.** A fleshy, spineless fin back of the dorsal fin in certain fishes.

**Adnate.** Grown together; a fin which is attached along its lower edge as well as by its base.

**Adult.** A mature, sexual animal.

**Adventitious.** Coming from without; foreign.

**Æstivate.** To pass the summer in a torpid condition.

**Air bladder.** A large sac filled with air or some other gas lying beneath the backbone in the body cavity of most fishes.

**Albinism.** A more or less complete lack of pigment in the integument and eyes of an animal; opposed to melanism.

**Allantois.** The embryonic respiratory organ of the higher vertebrates.

**Alveoli.** Deep pits in a bone; the sockets of the teeth.

**Amnion.** The protective envelope of the embryo of the higher vertebrates.

**Amniota.** Those vertebrates possessing an amnion.

**Amniotic.** Pertaining to the Amniota.

**Amphicœlous.** Biconcave vertebræ.

**Amphioxus.** One of the most primitive chordate animals.

**Anadromous.** Marine fishes which run up rivers to spawn.

**Anal.** Pertaining to the anal region of the body.

**Anal fin.** The median fin just behind the anus.

**Anal glands.** Glands in connection with the anus which secrete an odoriferous fluid.

**Anal plate.** The plate immediately in front of the anus in snakes.

**Analogous.** Having a similar function.

**Anamnia.** Those vertebrates which do not possess an amnion.

**Anchylosed.** Grown firmly together.

**Anteorbital plate.** The plate in front of the eye in snakes.

**Anterior.** Toward the front end of an animal.

**Anus.** The hinder opening of the digestive tract.

**Aorta.** The main artery which carries blood away from the heart.

**Aplacental.** Not having a placenta.

**Apodous.** Without feet.

**Appendage.** A projection from some part of the body, usually applied to the locomotory appendages, the legs.

**Appendicular.** Pertaining to the locomotory appendages.

**Aquatic.** Living in the water.

**Arboreal.** Living in trees.

**Arciferous.** Referring to the pectoral girdle of toads, the cartilaginous elements of which overlap midventrally.

**Articulate.** Jointed.

**Artiodactyle.** Even-toed, of ungulates.
**Ascidians.** Very primitive chordate animals.
**Atrophy.** The state of being undeveloped.
**Attenuate.** Long and slender and drawn to a point.
**Auburn.** Dark reddish brown.
**Auricle.** One of the chambers of the heart.
**Azygos plate.** A plate just back of the rostral plate on the head of some snakes.
**Balanoglossus.** A very primitive chordate animal.
**Barbel.** A long, slender projection on the head of certain fishes and turtles.
**Basal.** At or near the base.
**Bicolor.** Two-colored.
**Bicuspid.** Having two terminal points.
**Bifid.** Forked.
**Bilateral symmetry.** Having the right and left sides alike.
**Bister.** A dark brown color.
**Branchial.** Pertaining to the gills.
**Branchiostegals.** The bony rays which support the branchiostegal membrane on the under side of the head of a fish.
**Buccal.** Pertaining to the mouth.
**Buccal funnel.** The depressed plate with the mouth in its center at the front end of a lamprey.
**Caducous.** Shedding or falling off early.
**Cæcum.** A sac-like appendage of the digestive tract; a blind-gut.
**Canine teeth.** Elongate, conical teeth; in mammals those next to the incisors.
**Carapace.** The upper shell of a turtle; the shell of an armadillo.
**Carinate.** Keeled; with a median ridge.
**Carnassial teeth.** The flesh-cutting teeth of a carnivorous mammal.
**Carnivorous.** Flesh-eating.
**Carpal bones.** The wrist bones.
**Carpus.** The wrist.
**Caudal.** Pertaining to the tail.
**Caudal fin.** The tail fin of fishes.
**Caudal peduncle.** The slender body region just in front of the caudal fin in fishes.
**Cavernous.** Containing cavities.
**Cervical.** Pertaining to the neck.
**Cheek.** The part of a fish's head beneath and behind the eye.
**Chordate.** Pertaining to animals belonging to the Phylum *Chordata*, being those animals possessing a notochord, such as vertebrates, ascidians, etc.
**Cinereous.** Ashen; light gray.
**Cinnamon.** Intense dark brown.
**Cirri.** Filamentous, sensory appendages.
**Clavicle.** The collar bone, the ventral, anterior portion of the shoulder girdle.
**Cloaca.** The tubular organ receiving the discharges of the digestive, urinary and reproductive systems, in certain vertebrates.
**Cochlea.** A portion of the inner ear in mammals which is spiral in shape.
**Compressed.** Flattened laterally.
**Condyle.** A bony projection which is an articulating surface.
**Coracoid.** The ventral, posterior portion of the shoulder girdle in the land vertebrates; the principal bone of the shoulder girdle in fishes.
**Costal folds.** Vertical folds of the skin in salamanders which show the number of the muscle segments.
**Costal grooves.** The vertical grooves between the costal folds.
**Costals.** The lateral plates of a turtle's carapace.

**Cranial crests.** A pair of longitudinal ridges between the eyes on the head of toads.
**Cranium.** The portion of the skull which encloses the brain.
**Cruciform.** Cross-shaped.
**Ctenoid.** Fish scales which have a pectinated or roughened posterior margin.
**Cusp.** A sharp projection.
**Cuspidate.** Ending in one or more sharp points.
**Cycloid.** Fish scales which have a smooth posterior margin.
**Cyclostomate.** Round-mouthed; a group of primitive fish-like vertebrates.
**Deciduous.** Temporary; characterized by falling off at a certain time.
**Decurved.** Curved downwards.
**Dentate.** Notched.
**Dentine.** The very hard, inner substance of a tooth; ivory.
**Dentition.** The number of each of the four kinds of teeth of a mammal.
**Depressed.** Flattened dorso-ventrally.
**Depth.** The dorso-ventral height of a fish's body at the widest place.
**Dermal.** Arising in the dermis of the skin.
**Dermis.** The inner layer of the vertebrate skin or integument.
**Dextral.** Pertaining to or situated on or towards the right hand.
**Diaphragm.** The muscular septum between the thoracic and abdominal cavities in mammals.
**Dicromatic.** Two-colored; applied to animals having two color phases.
**Digit.** A finger or toe.
**Digitigrade.** Walking on the toes instead of on the flat of the foot.
**Dimorphic.** Characterized by dimorphism.
**Dimorphism.** Existing in two distinct forms.
**Distal.** Away from the point of attachment; opposed to proximal.
**Diurnal.** Appearing or active during the day.
**Diverticulum.** A sac-like projection of a tubular organ.
**Dorsal.** Pertaining to the back.
**Dorsal fin.** The median fin on the back of a fish or amphibian.
**Dorsals.** The median plates of a turtle's carapace.
**Dorso-lateral ridges.** A pair of glandular ridges on the back of most frogs.
**Ear-ossicles.** The three minute bones in the middle ear of mammals.
**Ecru.** Coffee-color.
**Ectoderm.** The outermost layer of cells in the body of an embryo.
**Elaphine snakes.** Snakes which have a pair of short rigid poison fangs in the front of the upper jaw.
**Elasmobranch fishes.** Sharks and skates.
**Emarginate.** Slightly forked or notched.
**Embryo.** A young animal which is passing through its developmental stages, usually within the egg-membranes or in the maternal uterus.
**Enamel.** The very hard outer covering of a tooth.
**Endoskeleton.** The inner bony or cartilaginous framework of the body.
**Entire.** Not divided or split.
**Entoderm.** The embryonic cell layer which forms the mucous membrane of the digestive tract.
**Epidermal.** Arising in the epidermis of the skin.
**Epidermis.** The outer layer of the vertebrate skin or integument.
**Eustachian tube.** A canal joining the middle ear with the pharynx.
**Exoskeleton.** The hard parts, as the nails, scales, feathers, hair, etc., on the outer surface of the body.
**Extremities.** The paired locomotory appendages of the body, as the legs, wings, etc.
**Falcate.** Scythe-shaped; elongate, slender and curved.

**Falciform.** Scythe-shaped.
**Fauna.** The animals inhabiting a region.
**Femoral.** Pertaining to the thigh.
**Femoral pores.** A row of pores on the thigh of many lizards.
**Ferruginous.** Reddish brown.
**Filament.** A thread-like structure.
**Filiform.** Thread-like in form.
**Fin-rays.** The small bony or cartilaginous projections of the gill arches.
**Firmisternal.** Referring to the pectoral girdle of frogs, the cartilaginous elements of which overlap midventrally.
**Flipper.** The fin-shaped legs of certain aquatic turtles and mammals.
**Fontanelle.** An unossified space in a bone.
**Foramen.** An opening.
**Forficulate.** Deeply forked.
**Frontal bones.** The bones forming the top of the head in front.
**Frugivorous.** Fruit-eating.
**Fulcra.** Spine-like projections of the fin-rays in certain fishes.
**Fulvous.** Reddish-yellow; tawny.
**Furcate.** Forked.
**Fuscous.** Dusky.
**Fusiform.** Spindle-shaped; tapering towards ends.
**Ganoid.** A representative of the Ganoidea.
**Ganoid scales.** Rhombic scales of many ganoid fishes.
**Gastrosteges.** The transverse plates which cover a snake's belly; the ventral plates.
**Gills.** The organs of respiration of a fish and of many amphibians.
**Gill-arches.** The bony or cartilaginous arches which support the gills.
**Gill-clefts.** The openings between the pharynx and the outside in which the gills are located.
**Gill-rakers.** A series of projections along the inner margin of certain of the gill-arches.
**Gill-slits.** The gill-clefts.
**Glottis.** The opening from the pharynx into the trachea.
**Granulate.** Roughened; with granular prominences.
**Grinders.** The molar and premolar teeth of rodents and some other mammals, the surfaces of which grind the food.
**Gular.** Pertaining to the upper part of the throat.
**Hazel.** Dark brown.
**Height.** The vertical dimension of an animal.
**Heterocercal fin.** An unsymmetrical caudal fin of a fish, the upper lobe being usually longer than the lower and containing the backbone.
**Hibernate.** To pass the winter in a torpid condition.
**Hirsute.** Shaggy.
**Homocercal fin.** A symmetrical caudal fin of a fish, the backbone ending at the base of the fin and not entering it.
**Homologous.** Having a common origin.
**Hyoid.** The bones which support the tongue.
**Ichthyopsida.** Fish-like vertebrates, those that breathe in the water at some time of their lives.
**Imbricate.** Overlapping, like the shingles on a roof.
**Incised.** Cut into; deeply notched.
**Incisors.** The front teeth.
**Inferior.** In a lower position.
**Infraoral lamina.** The toothed plate or ridge posterior to the mouth of a lamprey.
**Integument.** The skin.

**Interfemoral membrane.** The portion of the flying membrane of bats which connects the hind legs and includes a part of the tail.

**Intermaxillaries.** The premaxillaries; the middle portion of the upper jaw, except in mammals.

**Internasals.** The plates on a snake's head which connect the two nostrils.

**Interopercle.** The opercular bone between the preopercle and the branchiostegals.

**Interorbital.** The space between the eyes.

**Interparietal.** A median bone sometimes present between the posterior portion of the parietals.

**Interspinals.** Spine-like bones inserted between the neural spines in fishes, often for the support of the fins.

**Isthmus.** The midventral space lying between the right and the left gill-clefts of a fish.

**Jugular.** Applied to the ventral fins of a fish when they are anterior to the pectorals.

**Keel.** A longitudinal ridge along the middle of a scale or other organ.

**Keeled.** Having a ridge along the middle.

**Labials.** The scales lying along the lips of a snake or lizard.

**Lamella.** A leaf- or plate-like structure.

**Lamellate.** Composed of or provided with lamellæ.

**Lamina.** A plate-like process.

**Larva.** A young, immature animal which has not yet acquired the form and appearance of the adult.

**Lateral.** Toward either the right or the left side.

**Lateral line.** A sensory line on the lateral surface of most fish, extending usually between the head and the tail-fin.

**Lenticular.** Doubly convex.

**Longitudinal.** Lengthwise.

**Loreal plate.** The plate between the eye and the nostril on the head of a snake or a lizard, just in front of the preocular when it is present.

**Lumbar.** Pertaining to the region of the body between the thorax and the sacrum.

**Lunate.** Crescent-shaped; with the form of the new moon.

**Mammæ.** The nipples on the ventral surface of a mammalian female.

**Mammary glands.** The milk-secreting glands of the mammalian female.

**Mandible.** The lower jaw.

**Marginals.** The marginal plates of a turtle's carapace.

**Marsupial pouch.** The pouch on the belly of the marsupial female in which the young are kept.

**Marsupium.** The marsupial pouch.

**Mastoid region.** The region just behind the ear.

**Maxilla.** The upper jaw.

**Maxillaries.** The lateral bones of the upper jaw.

**Median fins.** The unpaired fins.

**Melanic.** The tendency to develop melanism.

**Melanism.** An unusual or abnormal accumulation of black pigment in the integument and eyes of an animal; opposed to albinism.

**Membrane bone.** A bone which forms in a superficial membrane and not in cartilage.

**Meroblastic.** Eggs the germinal disc of which alone undergoes segmentation.

**Metabolism.** The sum of all the vital processes of an animal's body.

**Metachrosis.** The attribute of changing the body color under the influence of some sensory stimulus.

**Metameric.** Pertaining to the body segments; segmental.

**Metamorphosis.** The developmental changes which go on in a young animal's body up to the time when it becomes adult.

**Molars.** The hindermost teeth in the mammalian jaw; crushing teeth of certain fishes.

**Monozygotic.** The several offspring which may develop from a single fertilized egg, such as identical twins.
**Murine.** Mouse-like.
**Naked.** Without external coverings, such as hair, scales, etc.
**Nape.** The back of the neck.
**Nares.** The nostrils, both those opening on the outer surface of the head and the inner ones opening into the mouth cavity.
**Nasal.** Pertaining to the nose or the nostrils.
**Nasal plate.** The plate in which the nostril is located in snakes and lizards.
**Naso-labial groove.** A glandular groove connecting the nostril and the lip in certain salamanders.
**Nictitating membrane.** The eye-lid at the inner corner of the eye of certain vertebrates, which moves across the surface of it.
**Nocturnal.** Being active in the night-time.
**Nose-leaf.** A complicated membrane at the end of the snout in certain bats.
**Notochord.** A cylindrical rod which extends the length of the body in chordate embryos and forms the basis of the backbone.
**Nuchal plate.** The median anterior marginal plate in the carapace of turtles.
**Obscure.** Indefinite in appearance.
**Obsolescent.** Gradually disappearing.
**Obsolete.** Scarcely visible.
**Obtuse.** Blunt.
**Occipital.** Pertaining to the hinder part of the head.
**Occipital condyle.** The bony prominence by which the skull articulates with the backbone.
**Ochraceous.** Light brownish yellow in color.
**Œsophagus.** The portion of the digestive tract between the pharynx and the stomach.
**Olivaceous.** Yellowish green.
**Omnivorous.** Eating all kinds of food.
**Opercle.** The gill cover; the movable flap on the side of a fish's head which covers the gill clefts.
**Opercular bones.** Membrane bones which support the opercle.
**Opercular flap.** The posterior prolongation of the opercle in certain fishes.
**Operculum.** The opercle.
**Opisthocœlous vertebræ.** Those which are concave behind and convex in front.
**Opisthoglyph snakes.** Snakes which have poison fangs in the rear of the mouth.
**Orbicular.** Circular or nearly so.
**Orbit.** The socket of the eyes.
**Orientation, Organs of.** The special sense organs.
**Oviparous.** Egg-laying.
**Ovoviviparous.** Animals producing large eggs which hatch while still in the mother's body.
**Paired fins.** The pectoral and ventral fins of a fish.
**Palate.** The roof of the mouth.
**Palatines.** Membrane bones supporting the rear portion of the roof of the mouth.
**Palmate.** Spreading; broad and flat, with finger-like projections.
**Papilla.** A minute, fleshy projection.
**Papillose.** Covered with papillæ.
**Parasphenoid.** The membrane bone supporting the roof of the mouth in amphibians.
**Parotoid.** A glandular organ just back of the ear in toads.
**Parietal bones.** A pair of membrane bones forming a portion of the top of the skull.
**Pectinate.** Having teeth like a comb.
**Pectoral.** Pertaining to the breast.
**Pectoral fins.** The anterior paired fins in fishes.

**Pedicle.** A stalk.
**Pelagic.** Living in the surface waters of the sea or a lake.
**Pelvis.** The bony girdle by which the skeleton of the hind legs is joined with the vertebral column; the pelvic girdle.
**Pencil.** A tuft of hair or feathers.
**Penicillate.** Tipped with a tuft of hairs.
**Pentadactylous.** Five-fingered or five-toed; pentadactyle.
**Perforate.** Pierced.
**Peritoneum.** The lining of the abdominal cavity.
**Phalanges.** The bones of the finger and toes.
**Pharyngeal bones.** Bones behind the gill arches in fishes which usually bear teeth.
**Pharynx.** The anterior portion of the digestive tract, that just back of the mouth.
**Phylum.** One of the main subdivisions of the Animal Kingdom; a Sub-kingdom.
**Pigment.** Coloring matter.
**Pineal eye.** A rudimentary median eye on the top of the head of certain lizards.
**Placenta.** The organ by which the fetus of the higher mammals is nourished.
**Placoid scales.** The scales of sharks and skates.
**Plantar.** Referring to the under surface of the foot or hand.
**Plantigrade.** Walking on the sole of the foot.
**Plastron.** The lower portion of the turtle's shell.
**Pleurodont teeth.** Teeth which are situated along the inner margin of the jaw bone.
**Plicate.** Folded; wrinkled.
**Plumbeous.** Lead-colored.
**Pneumatic duct.** A duct joining the air bladder with the pharynx in fish.
**Postanal.** Back of the anus.
**Posterior.** Toward the hinder end of the animal.
**Postnatal.** Occurring after birth.
**Postorbital plate.** The plate behind the eye in snakes and lizards.
**Postorbital processes.** The bony processes which form the hinder part of the orbit.
**Precoracoid.** The anterior, ventral portion of the shoulder girdle in amphibians.
**Prefrontal plate.** The plate on the head of snakes and lizards in front of the frontal.
**Prehensile.** Adapted for grasping and holding.
**Prehension, Organs of.** Organs fitted for seizing.
**Premaxillaries.** The bones which support the front portion of the upper jaw; in fishes they extend also along the side.
**Premolar teeth.** The teeth in the mammalian jaw between the canines and the molars.
**Preocular plate.** The plate on the head of snakes and lizards just in front of the eye.
**Preopercle.** The membrane bone forming the anterior portion of the opercle in fishes.
**Presacral vertebræ.** Those anterior to the sacrum.
**Proboscis.** An elongation of the snout or lips for purposes of prehension.
**Procœlous vertebræ.** Those which are concave in front and convex behind.
**Protractile.** Capable of being thrust forward.
**Proximal.** Toward the point of attachment; opposed to distal.
**Pseudobranchiæ.** Small gills on the inner surface of the opercle.
**Pterygoid bones.** Bones in the roof of the mouth.
**Pubic bones.** Plate-like bones on the belly of sticklebacks just in front of the anus.
**Pubis.** The ventral, anterior portion of the pelvis.
**Pulmonary.** Pertaining to the lungs.
**Punctate.** Dotted with minute points.
**Punctulations.** Dots.
**Pustulate.** Having minute pimple-like elevations.
**Pyloric cæca or appendages.** Elongated, blind sacs opening into the intestine at the point where it joins the stomach in fishes.

**Quadrate bone.** The bone which joins the lower jaw, on each side, with the cranium, in the lower vertebrates.
**Recurved.** Curved upwards.
**Reticulate.** Marked with a net-work of lines.
**Retractile.** Capable of being drawn in.
**Rhombic.** Diamond-shape.
**Rostral.** Pertaining to the end of the snout.
**Rostral plate.** A plate on the head of snakes and lizards at the tip of the snout.
**Rudimentary.** Undeveloped.
**Rufous.** Reddish; yellowish red.
**Rugose.** Roughened or wrinkled.
**Ruminant.** Chewing the cud.
**Russet.** Reddish or yellowish brown.
**Sacral.** Pertaining to the sacrum or the sacral region.
**Sacrum.** The dorsal portion of the pelvis.
**Sanguivorous.** Blood-sucking.
**Sauropsida.** Reptilian-like vertebrates.
**Scalation.** Pertaining to the scales.
**Scapula.** The shoulder-blade.
**Segmental.** Arranged in definite segments.
**Selachian fish.** Sharks and skates.
**Sepia.** Light brown.
**Septum.** A partition separating two spaces.
**Serræ.** Notches; serrations.
**Serrate.** Notched; jagged, like the teeth of a saw.
**Sessile.** Attached by the base and not stalked.
**Setaceous.** Bristly.
**Shoulder girdle.** The bony girdle by which the skeleton of the fore legs is joined with the trunk.
**Sinistral.** Pertaining to or situated on or towards the left hand.
**Soft rays.** Fin rays which are jointed and not stiff and sharp.
**Spatulate.** Shaped like a spatula; more or less spoon or trowel-shaped.
**Sphenoid.** One of the basal skull bones.
**Spine.** A sharp projecting point.
**Spinous.** Composed of spines.
**Spiracles.** Openings of the head in certain fish and amphibians for the passage of respiratory water.
**Spiral valve.** A spiral fold in the intestine of certain fish.
**Sternum.** The breast-bone.
**Striate.** Striped or streaked.
**Subcaudal plates.** The ventral plates of a snake's tail; the urosteges.
**Subconical.** Imperfectly conical.
**Subcylindrical.** Imperfectly cylindrical.
**Subfusiform.** Imperfectly fusiform.
**Subopercle.** The membrane bone just beneath the opercle in fishes.
**Suborbital plate.** The plate beneath the eye in snakes and lizards.
**Subphylum.** A main subdivision of a phylum.
**Subrhombic.** Imperfectly rhombic.
**Sulcate.** Grooved.
**Superciliary plates.** The plates just above the eye in certain snakes and lizards.
**Superior.** In a higher or more elevated position.
**Supplementary maxillary bone.** A small bone just above the maxillary in certain fish.

**Supraoccipital process.** A dorsally situated bony crest at the hinder end of the skull in fish.
**Supraoral lamina.** The toothed plate or ridge anterior to the mouth of a lamprey.
**Supraorbital.** Above the eye.
**Symphysis.** The firm union of two bones.
**Tail.** The postanal portion of the body.
**Teleost.** A representative of the Teleostei; a bony fish.
**Temporal.** Pertaining to the temples or the side of the head.
**Terminal.** At or toward the end.
**Terrestrial.** Living on or near the surface of the ground.
**Tessellated.** Marked with a checkered, mosaic-like arrangement.
**Tetrapodous.** Four-footed.
**Thoracic.** Pertaining to the thorax, or the anterior portion of the trunk; applied to the ventral fins of a fish when they are just beneath the pectorals.
**Thorax.** The anterior portion of the trunk.
**Trachea.** The wind-pipe.
**Tragus.** A projection in the external ear of bats.
**Transverse.** In a plane at right-angles to the longitudinal plane.
**Tricuspid.** With three terminal points.
**Truncate.** Ending abruptly, as if cut squarely across.
**Tubercle.** A small elevation.
**Tympanum.** The ear-drum.
**Typical.** Of a character usual to a particular group.
**Ultimate.** The last or terminal member of a number of structures.
**Unguiculate.** Having claws.
**Ungulate.** Hoofed.
**Unicolor.** Of a single color.
**Unicuspid.** With a single terminal point.
**Urosteges.** The ventral plates of a snake's tail; the subcaudals.
**Urostyle.** A bone extending back from the pelvis in frogs and toads.
**Ventral.** Pertaining to the under side.
**Ventral fins.** The posterior paired fins of a fish.
**Ventral plates.** The tranverse plates on the belly of a snake; the gastrosteges.
**Ventricle.** The posterior portion of the heart.
**Vermiform.** Shaped like a worm.
**Vertebræ.** The bones which form the spinal column.
**Vertical.** A dorso-ventral position.
**Vertical fins.** The median fins.
**Vertical plate.** The central plate on the snake's head.
**Vesicle.** A small or minute cavity.
**Vesicular.** Composed of vesicles.
**Villiform teeth.** Teeth of certain fishes which are small, slender and crowded together.
**Villose.** More or less covered with short, finger-shaped projections.
**Viperine snakes.** Snakes which have a pair of long movable fangs in the front of the upper jaw.
**Viscera.** The internal organs of an animal.
**Visceral arches.** The bony or cartilaginous arches which support the mouth and gills of fishes.
**Visceral skeleton.** The portion of the skull which forms the frame-work of the jaws, tongue and gill arches.
**Viscous.** Slimy.
**Viviparous.** Bringing forth the young alive.
**Vomer bones.** The membrane bones forming the roof of the anterior portion of the mouth.

**Weberian ossicles.** A series of small bones connecting the air-bladder with the ear in certain fishes.

**Ypsiloid cartilage.** A Y-shaped cartilage which projects forward from the pubis in certain salamanders.

**Zygomatic bone.** The cheek bone.

# INDEX

Specific names begin with small letters and are accompanied each by the name of its genus in parentheses; all other names begin with capital letters. Synonyms are in italics.


abacura (Farancia), 214
Abastor, 213
aberti (Sciurus), 340
    (Sciurus aberti), 341
abietorum (Peromyscus maniculatus), 305
Abramis, 73
acadicus (Microtus pennsylvanicus), 316
Acantharchus, 115
Acanthopteri, 108
Achirus, 143
Acipenser, 30
Acipenseridæ, 29
Acris, 178
Acrocheilus, 65
acutus (Crocodylus), 190
adamanteus (Crotalus), 233
adobe (Agosia), 87
æneus (Aneides), 160
*æpytera* (*Lampetra*), 27
æsopus (Rana), 182
æstivalis (Hybopsis), 88
æstivus (Opheodrys), 216
affinis (Gambusia), 105
agassizii (Salvelinus fontinalis), 49
    (Chologaster), 107
    (Gopherus), 249
agilis (Perodipus), 332
Agkistrodon, 231
Agosia, 86
alabamæ (Alosa), 37
alabamensis (Pseudemys), 248
alacer (Sylvilagus floridanus), 358
alascanus (Callorhinus), 297
albatus (Ochotona), 360
albeolus (Notropis), 81
albescens (Reithrodontomys), 302
albibarbis (Neosorex), 263
albifrons (Peromyscus polionotus), 306
albigula (Neotoma), 312
    (Neotoma albigula), 312
albipes (Phenacomys), 320
albiventer (Neosorex bendiri), 264
albolimbatus (Sciurus douglasi), 340
albolineatus (Fundulus), 102
albus (Parascaphirhynchus), 31
Alces, 365
Alewife, 36
alexandrinus (Mus), 299
aliciæ (Leuciscus), 70
alleganiensis (Cryptobranchus), 148
allegheniensis (Putorius), 284
alleni (Citellus tridecemlineatus), 347
    (Lepus), 356
    (Liodytes), 229
    (Neofiber), 319
    (Putorius), 285
    (Zapus trinotatus), 334
Alligator, 189, 190
    gar, 32
    snapper, 239
aloga (Blarina brevicauda), 265
Alosa, 36
alosoides (Hiodon), 35
alpinus (Eutamias minimus), 345
    (Salvelinus), 49
    (Scapanus latimanus), 260
    (Sciuropterus), 353
    (Thomomys), 326
altipinnis (Notropis), 82
alutaceus (Acrocheilus), 65
alvarius (Bufo), 173
amabilis (Diadophis), 214
*Amiatus*, 32
amaura (Lampropeltis triangulum), 222
ambarvalis (Spilogale), 290
ambigua (Spilogale), 291
Ambloplites, 116
amblops (Hybopsis), 89
amblyceps (Ursus americanus), 274
Amblyopsidæ, 107
Amblyopsis, 107
Ambystoma, 149
Ambystomidæ, 148
Ameiurus, 93

Ameiurus, cantonensis, 93
American badger, 291
jackal 275
otter, 292
rats and mice, 299
sable, 281
saibling, 49
smelt, 50
americana (Antilocapra), 366
(Morone), 138
(Mustela), 281
americanus (Alces), 365
(Bison), 367
(Bufo), 171
(Esox), 99
(Lepus), 355
(Lepus americanus), 355
(Odocoileus), 364
(Odocoileus americanus), 364
(Ursus), 273
(Ursus americanus), 274
(Zapus hudsonius), 334
Amia, 32
Amiidæ, 32
Ammocœtes, 25
Ammocrypta, 131
Ammospermophilus, 346
Amniota, 13
amœnus (Carphophis), 213
(Eutamias), 344
(Sorex), 262
Amphiardis, 227
Amphibians, 144
Amphiuma, 148
Amphiumidæ, 148
Amyda, 249
Anacanthini, 142
Anamnia, 13
anastasæ (Scalopus aquaticus), 258
andersoni (Hyla), 177
Aneides, 160
Anguidæ, 202
Anguilla, 51
anguilla (Ictalurus), 93
Anguillidæ, 51
angularis (Thomomys bottæ), 326
angulatus (Pecari), 362
angusticeps (Microtus), 317
animosus (Eutamias quadrivittatus), 344
anisurum (Moxostoma), 60
annæ (Cottus), 141
annectans (Citellus spilosoma), 348
annectens (Neotoma fuscipes), 313
Anniella, 203
Anniellidæ, 203
annularis (Pomoxis), 115
annulatum (Ambystoma), 152
anogenus (Notropis), 77
Anolis, 194
anomalum (Campostoma), 65
Antelope chipmunks, 346
jack rabbit, 356
Antelopes, 366
anthonyi (Sciurus griseus), 340
anthracinus (Plestiodon), 206
Antilocapra, 366
Antilocapridæ, 366
Antrozous, 272
*Anura*, 166
apache (Perognathus), 329
(Sciurus), 342
Apeltes, 111
Aphredoderidæ, 113
Aphredoderus, 113
Aplodinotus, 138
Aplodontia, 336
Aplodontiidæ, 336
Apodes, 50
appendix (Entosphenus), 27
aqua-bonita (Salmo), 47
aquaticus (Scalopus), 257
(Scalopus aquaticus), 258
(Syvilagus), 360
aquilarum (Salmo), 47
Archoplites, 116
*Arctomys*, 350
ardens (Catostomus), 57
(Notropis umbratilis), 84
arenarius (Geomys), 324
arenicolor (Hyla), 177
arens (Citellus spilosoma), 348
areolata (Gastrophryne), 184
(Rana), 182
argentatus (Tetragonopterus), 91
Argentinidæ, 50
aridulus (Peromyscus leucopus), 307
ariommus (Notropis), 82
Arizona, 220
white-tail, 365
arizonæ (Neotoma cinerea), 313
(Peromyscus leucopus), 307
(Sigmodon hispidus), 310
(Spilogale), 291
(Sylvilagus auduboni), 359
arizonensis (Cynomys ludovicianus), 350
(Microtus montanus), 317
(Putorius), 285
(Sciurus), 342

armatus (Citellus), 348
arnyi (Diadophis), 214
artedi (Leucichthys), 40
artemisia (Peromyscus maniculatus), 305
Artibeus, 267
articeps (Onychomys leucogaster), 301
Artiodactyla, 361
arundivaga (Felis), 294
arvicoloides (Microtus richardsoni), 318
Ascaphus, 168
asper (Cottus), 140
asprella (Crystallaria), 130
aspro (Hadropterus), 125
astutus (Bassariscus), 280
aterrimus (Dicamptodon), 149
Atherinidæ, 112
atherinoides (Notropis), 83
atkinsi (Gasterosteus bispinosus), 110
Atlantic salmon, 44
atripes (Notropis umbratilis), 84
atromaculatus (Semotilus), 68
atronasus (Rhinichthys), 86
atrox (Crotalus), 233
attenuatus (Batrachoseps), 160
attwateri (Geomys breviceps), 324
(Neotoma floridana), 311
(Peromyscus boylei), 307
audens (Menidia), 112
auduboni (Ovis canadensis), 367
(Sylvilagus), 359
(Sylvilagus auduboni), 359
aurantiacus (Hypohomus), 127
aurantius (Reithrodontomys fulvescens), 303
auratus (Carassius), 64
aureolum (Moxostoma), 60
aureolus (Peromyscus nuttalli), 308
(Salvelinus), 49
aureus (Thomomys perpallidus), 326
auricularis (Pitymys pinetorum), 319
auriculata (Desmognathus fusca), 156
auritus (Lepomis), 118
aurora (Rana), 183
austerus (Peromyscus maniculatus), 305
australis (Scalopus aquaticus), 258
avara (Marmota flaviventris), 351
avia (Mephitis mesomelas), 289
Axylotl, 151
azteca (Felis oregonensis), 294
aztecus (Reithrodontomys megalotis), 302

bachmani (Sylvilagus), 359
(Sylvilagus bachmani), 359
Badgers, 291
badius (Citellus tridecemlineatus), 347
baileyi (Lynx), 296
(Myotis), 268
(Neotoma floridana), 311
(Sciurus hudsonicus), 338
(Sylvilagus auduboni), 359
bairdi (Lepus), 356
(Peromyscus maniculacus), 306
(Sorex), 262
Ball snake, 211
balteatus (Leuciscus), 71
Banded-gecko, 193
pickerel, 99
bangsi (Sciuropterus alpinus), 353
Barren-grounds caribou, 366
Bass, 120, 137
Bassariscus, 280
Bastard turtle, 251
bathœcetor (Salmo), 46
Batrachia, 144
Batrachoseps, 160
Bats, 265
baudini (Hyla), 177
bauri (Kinosternon), 238
beani (Ammocrypta), 131
beardsleei (Salmo), 46
Bears, 273
Beavers, 353
beecheyi (Citellus grammurus), 348
beldingi (Citellus), 349
(Cottus), 141
belli (Chrysemys marginata), 246
bendirei (Uranidea), 141
bendiri (Neosorex), 264
(Neosorex), 264
bennetti (Lepus californicus), 357
berlandieri (Cryptotis), 265
(Gopherus), 249
(Sigmiodon hispidus), 310
(Taxidea taxus), 292
bernardinus (Callospermophilus), 345
(Eptesicus fuscus), 270
beryllina (Menidia), 112
bicolor (Leuciscus), 70
(Rutilus), 72
bifrenatus (Notropis), 76
Big brown bat, 270
Big-eared bat, 272
Big-jawed sucker, 61
Bighorn, 367
Billfish, 168
bislineata (Eurycea), 163
bislineata (Eurycea bislineata), 163
Bison, 367

bispinosus (Gasterosteus), 110
Black-banded sunfish, 117
Black bass, 120
  buffalo, 53
  bullhead, 94
Black-footed ferret, 287
Black fox, 277
Black-nosed dace, 86
Black rat, 299
Black-sided darters, 124
Black snakes, 216
Black-spotted trout, 44
Black-tailed jack rabbit, 356
Black-tail deer, 365
Blackfin, 41, 84
Blackhorse, 55
blainvilli (Phrynosoma), 201
  (Phrynosoma blainvilli), 201
blandingi (Emys), 242
Blarina, 264
blennioides (Diplesion), 129
blennius (Notropis), 77
Blind fishes, 107
Blue racer, 217
Blue-back, 46
Blue-breasted darter, 133
Blueback, 40, 43
  trout, 49
Bluefin, 41
Bluegill, 119
Blunt nose, 67
Boas, 211
Bobcat, 295
Boidae, 211
Boleichthys, 136
Boleosoma, 129
bollmani (Opsopœodus), 73
Bony ganoids, 31
Bony-tail, 69
Boomers, 336
borealis (Eutamias quadrivittatus), 344
  (Nycteris), 271
  (Nycteris borealis), 271
  (Odocœleus americanus), 364
  (Urocyon cinereoargenteus), 278
boreas (Bufo), 174
  (Bufo boreas), 174
boreum (Stizostedion canadense), 124
bosci (Abramis crysoleucas), 73
bottæ (Charina), 211
  (Thomomys), 325
  (Thomomys bottæ), 325
bouvieri (Salmo), 45
Bovidæ, 366
Bowfins, 32
Box-turtles, 242
boylei (Peromyscus), 307
  (Peromyscus boylei), 307
boyli (Lampropeltis getulus), 221
  (Rana), 183
  (Rana boyli), 183
Brachylagus, 360
Breams, 73
breviauritus (Onychomys leucogaster), 301
brevicauda (Blarina), 264
  (Blarina brevicauda), 264
brevicaudus (Evotomys), 321
  (Onychomys leucogaster), 301
breviceps (Geomys), 324
  (Moxostoma), 60
Brevicipitidæ, 184
brevirostre (Phrynosoma), 202
brevirostris (Chasmistes), 58
brevirostrum (Acipenser), 30
Brevoortia tyrannus, 36
breweri (Microtus), 316
  (Parascalops), 258
brimleyorum (Desmognathus), 156
Brook silversides, 113
  stickleback, 111
  trout, 48
Brown cat, 95
  rat, 299
  snake, 226
browni (Phyllorhynchus), 216
Brush rabbit, 359
bubalinus (Notropis), 79
bubalus (Ictiobus), 53
buccata (Ericymba), 85
buckleyi (Citellus grammurus), 348
Buffalo, 367
  fish, 52
Bufo, 170,
Bufonidæ 170
bulbivorus (Thomomys), 326
Bull snake, 219
bullatus (Thomomys talpoides), 327
Bullfrog, 181
Bullhead minnow, 74
Bullheads, 93
Burbot, 142
bursarius (Geomys), 324
butleri (Thamnophis), 228

cabezonæ (Perodipus), 332
cacomitli (Felis), 294
Calico bass, 115
californiæ (Lampropeltis getulus), 221

californicus (Bufo cognatus), 173
(Dipodomys), 333
(Evotomys), 321
(Lepus), 356
(Lepus californicus), 356
(Lynx ruffus), 295
(Macrotus), 267
(Microdipodops), 333
(Microtus), 317
(Microtus californicus), 317
(Myotis), 269
(Myotis californicus), 269
(Odocoileus hemionus), 365
(Perognathus), 331
(Perognathus californicus), 331
(Peromyscus), 308
(Sciuropterus alpinus), 353
(Sorex), 262
(Urocyon), 278
(Urocyon californicus), 279
(Ursus horribilis), 274
(Zalophus), 296
caligata (Marmota), 352
calligaster (Lampropeltis), 222
callipeplus (Eutamias), 345
Callisaurus, 195
callistius (Notropis), 79
Callorhinus, 297
Callospermophilus, 345
calva (Amia), 33
campestris (Lepus), 356
(Lepus campestris), 356
(Zapus hudsonius), 334
Campostoma, 65
camurum (Boleosoma), 130
(Etheostoma), 133
camurus (Notropis), 80
cana (Ficimia), 224
Canada lynx, 296
canadense (Stizostedion), 123
canadensis (Castor), 353
(Castor canadensis), 354
(Cervus), 363
(Lutra), 292
(Lutra canadensis), 292
(Lynx), 296
(Marmota monax), 351
(Ovis), 367
Candlefish, 50
Cane-cutter, 360
canescens (Microtus nanus), 318
canicaudus (Microtus), 318
Canidae, 274
Canis, 274
Canis familiaris, 274
canorus (Bufo), 174
cantabrigensis (Rana), 182
canus (Citellus mollis), 349
(Odocoileus hemionus), 365
(Thomomys perpallidus), 326
caprodes (Percina), 124
Carassius, 64
Caretta, 251
caretta (Caretta), 251
caribou (Rangifer), 366
carissima (Myotis), 268
Carnivora, 273
carolina (Terrapene), 243
(Terrapene carolina), 243
carolinensis (Anolis), 194
(Blarina brevicauda), 265
(Castor canadensis), 354
(Desmognathus ochrophæa), 157
(Evotomys), 321
(Gastrophryne), 184
(Sciurus), 340
(Sciurus carolinensis), 340
Carp, 64
suckers, 53
Carphophis, 213
carpio (Carpiodes), 54
(Cyprinus), 64
Carpiodes, 53
caryi (Eutamias minimus), 345
(Scalopus aquaticus), 258
cascadensis (Marmota caligata), 352
(Sciurus douglasi), 339
(Vulpes), 277
castanops (Cratogeomys), 325
castanurus (Callospermophilus), 346
Castor, 353
Castoridæ, 353
catalinæ (Reithrodontomys), 303
(Urocyon), 279
Catamount, 294
cataphractus (Gasterosteus), 110
cataractæ (Rhinichthys), 86
(Rhinichthys cataractæ), 86
catenatus (Fundulus), 102
(Sistrurus), 232
(Sistrurus catenatus), 232
catenifer (Pituophis), 220
catesbeiana (Rana), 181
Catfish, 91
Catostomidæ, 51
Catostomus, 55
catostomus (Catostomus), 56
(Phenacobius), 85
Catostomus rostratus, 55

Cats, 293
Cattle, 366
catulus (Ameiurus nebulosus), 94
catus (Ameiurus), 94
Caudata, 145
caurina (Mustela), 282
(Mustela caurina), 282
caurinus (Eutamias), 344
(Myotis californicus), 269
Cave rat, 311
Cavicornia, 366
Cayotes, 275, 276
cayuga (Eucalia inconstans), 111
(Notropis), 77
cedrophilus (Sylvilagus aududoni), 359
Cenophora, 223
Centrarchidæ, 114
Centrarchus, 115
centrata (Malaclemys), 244
(Malaclemys centrata), 244
cepedianum (Dorosoma), 35
cerasinus (Notropis), 80
cerastes (Crotalus), 234
cercostigma (Notropis), 79
Cervidæ, 362
Cervina, 362
cervinum (Moxostoma), 61
Cervus, 363
elephus, 363
Chænobryttus, 116
chætodon (Mesogonistius), 117
Chain pickerel, 99
Chain-snake, 221
chalybæus (Notropis), 82
Chameleon, 194
Channel cats, 92
chapmani (Sylvilagus floridanus), 358
Characinidæ, 91
Charina, 211
Chasmistes, 58
Chelonia, 250
Cheloniidæ, 250
Chelydra, 239
Chelydridæ, 239
cheneyi (Cottogaster), 128
Chicken snake, 218
turtle, 248
chiliticus (Notropis), 82
Chilomeniscus, 224
Chinook, 43
Chipmunks, 342
Chiroptera, 265
Chisel-mouth, 65
jack, 39
chlorocephalus (Notropis), 81
chlorus (Citellus), 349
Chologaster, 107
Chondrostei, 29
*Chondrotus tenebrosus*, 149
*Chorophilus*, 178
chrisypa (Anguilla), 51
Chromides, 139
Chrosomus, 66
chrosomus (Notropis), 82
chrotorrhinus (Microtus), 316
Chrysemys, 245
chrysochloris (Pomolobus), 36
chrysodeirus (Callospermophilus lateralis), 345
chrysogaster (Agosia), 87
chrysops (Roccus), 137
chrysoscelis (Hyla versicolor), 176
chrysotus (Fundulus), 103
Chub, 68, 69, 70
sucker, 59
Chuck-walla, 194
*cibaria* (*Lampetra*), 27
Cichlidæ, 139
cicognanii (Putorius), 284
ciliatus (Entosphenus tridentatus), 27
ciliolabrum (Myotis californicus), 269
cinerea (Hyla), 177
(Neotoma), 313
(Neotoma cinerea), 313
(Nycteris), 271
cinerascens (Callospermophilus), 346
(Sylvilagus bachmani), 360
cinereicollis (Eutamias), 344
cinereoargenteus (Urocyon), 278
(Urocyon cinereoargenteus), 278
cinereum (Etheostoma), 134
cinereus (Plethodon), 158
cingulatum (Ambystoma), 152
cingulatus (Fundulus), 103
cinnamomea (Ochotona), 361
cinnamomeus (Ammospermophilus leucurus), 346
cinnamominus (Fiber zibethicus), 323
cirrigera (Eurycea bislineata), 163
Ciscoes, 39
*Cistudo*, 242
Citellus, 346
Civet cat, 280
clamitans (Rana), 181
clara (Ammocrypta pellucida), 131
clarki (Natrix), 225
(Salmo), 44
(Sceloporus), 199

clementæ (Urocyon), 279
Clemmys, 240
Cliola, 73
Clupanodon pilchardus, 36
Clupea harengus, 36
clupeaformis (Coregonus), 38
Clupeidae, 36
clusius (Thomomys talpoides), 327
Cnemidophorus, 204
Coati, 280
Cobra, 230
coccinea (Cemophora), 223
coccogenis (Notropis), 81
Codfishes, 142
cœruleum (Etheostoma), 134
cœruleus (Gerrhonotus), 203
(Notropis), 79
cognatus (Bufo), 173
(Bufo cognatus), 173
(Sylvilagus floridanus), 358
Coleonyx, 193
Collared lizard, 195
Collared peccary, 362
collaris (Crotaphytus), 195
coloratus (Oryzomys palustris), 310
Coluber, 216
*Coluber*, 217
*Coluber emoryi*, 218
Colubridæ, 211
Columbia, 112
columbianus (Citellus), 348
(Odocoileus), 365
(Perodipus ordi), 332
(Rutilus), 72
commersoni (Catostomus), 57
Common box-turtle, 243
bullhead, 94
catfish, 94
chipmunk, 342
chub, 68
deer mouse, 306
field mouse, 316
garter snake, 228
horned toad, 200
killifish, 101
meadow mouse, 316
mole, 257
pickerel, 99
pike, 98
rabbit, 357, 358
rat, 299
rattlesnake, 233
redhorse, 60
shiner, 80
Common shrew, 261
skunk, 288
snapper, 239
spadefoot, 169
sucker, 57
sunfish, 120
toad, 171
tree toad, 176
water snake, 225
weasel, 283
white-footed mouse, 306
woodchuck, 350
compactilis (Bufo), 173
compressicauda (Natrix), 225
concentrica (Malaclemys centrata), 244
concinna (Pseudemys), 247
concinnus (Thamnophis sirtalis), 228
concolor (Ichthyomyzon), 25
Conepatus, 291
confinis (Elaphe obsoleta), 218
confluentes (Crotalus), 234
Congo snake, 148
Conies, 360
conocephalus (Mylopharodon), 68
consobrinus (Eutamias minimus), 345
(Sceloporus), 199
constrictor (Coluber), 217
(Coluber constrictor), 217
constrictus (Microtus californicus), 317
Contia, 222
*contortrix* (*Agkistrodon*), 231
(Heterodon), 215
Coon, 279
cooperi (Eutamias), 345
(Synaptomys), 319
Cooters, 246
copei (Chasmistes), 58
Copelandellus, 136
copelandi (Cottogaster), 127
Copperhead, 231
corais couperi (Drymarchon), 219
Coral king-snake, 222
snake, 230
Coregoninæ, 37
Coregonus, 37
coriacea (Dermochelys), 251
carinatus (Kinostenon), 238
Corn-snake, 218
cornutum (Phrynosoma), 200
cornutus (Chologaster), 107
(Notropis), 80
coronata (Tantilla), 229
corporalis (Semotilus), 68
coryi (Felis), 294

Corynorhinus, 272
Cottidæ, 139
Cottogaster, 127
Cotton rat, 310
Cottonmouth, 231
Cottontails, 357
Cottus, 139
couchi (Scaphiopus), 169
couesi (Agosia), 87
(Odocoileus), 365
Couesius, 90
Cougar, 294
cougar (Felis), 294
coulteri (Coregonus), 39
cragini (Etheostoma), 135
Crappie, 115
crassicauda (Leuciscus), 70
crassilabre (Moxostoma), 60
Cratogeomys, 324
crawfordi (Notiosorex), 265
crescentis (Salmo), 46
Cricetinæ, 299
Cricket frog, 178
crinitus (Peromyscus), 308
cristata (Condylura), 259
(Cystophora), 298
Cristivomer, 47
croceater (Ensatina), 160
croceus (Rhinichthys atronasus), 86
Crocodilia, 189
Crocodylidæ, 189
Crocodylus, 190
crooki (Odocoileus), 365
Crook's black-tailed deer, 365
Cross fox, 277
Crossopterygii, 29
Crotaphytus, 195
Crotalidæ, 230
Crotalus, 232
crucifer (Hyla), 177
Cryptobranchidæ, 148
Cryptobranchus, 148
Cryptotis, 265
cryptospilotus (Citellus), 348
crysoleucas (Abramis), 73
Crystallaria, 130
cujus (Chasmistes), 58
cumberlandicum (Etheostoma flabellare), 135
cuneus (Hypopachus), 184
curtatus (Lagurus), 318
Cut-lip, 91
Cutthroat trout, 44
cuvieri (Gasterosteus bispinosus), 110
cyanellus (Lepomis), 117
cyanocephalus (Notropis umbratilis), 84
(Nyctinomus), 273
cyanoguttatus (Heros), 139
cyanopterus (Leucichthys), 41
Cycleptus, 55
cyclopion (Natrix), 226
*Cyclophis*, 216
*Cyclostomata*, 24
Cyclostomes, 24
cymatotœnia (Hypohomus), 127
Cynomys, 349
cypho (Xyranchen), 59
cyprinella (Ictiobus), 53
Cyprinidæ, 61
Cyprinodon, 105
Cyprinus, 64
cyprinus (Carpiodes), 54
Cystophora, 297

Dace, 69, 80
dacota (Marmota flaviventris), 351
dakotensis (Chrosomus), 66
(Sciurus hudsonicus), 338
danielsi (Gyrinophilus), 162
Darters, 121, 128, 131
Dasypodidæ, 256
Dasypterus, 271
Dasypus, 256
debilis (Bufo), 173
declivifrons (Salmo), 45
decorticatum (Ambystoma), 152
*decumanus* (*Mus*), 299
Deer, 362
mice, 303
degener (Lutra), 292
Deirochelys, 248
dekayi (Storeria), 226
Dekay's snake, 226
deletrix (Vulpes), 277
delphinus (Pantosteus), 55
*Deltistes*, 58
Dermochelidæ, 251
Dermochelys, 251
Desert fox, 278
deserti (Dipodomys), 333
deserticola (Lepus californicus), 357
desèrtorum (Neotoma), 312
Desmognathus, 155
Diadophis, 214
Diamond-back rattlesnake, 233
terrapin, 244
diaphanus (Fundulus), 102
Dicamptodon, 149

Didelphis, 255
Didelphyidæ, 255
*Diemyctylus*, 153
difformis (Carpiodes), 54
dilatus (Scapanus latimanus), 260
dilectus (Notropis), 83
Diplesion, 128
Dipnoi, 28
Dipodomys, 332
Dipsosaurus, 194
discobolus (Catostomus), 56
Discoglossidæ, 168
dispar (Fundulus), 103
(Perognathus californicus), 331
(Sorex), 261
dissimilis (Couesius), 90
(Hybopsis), 89
dobsoni (Sorex vagrans), 262
Dog salmon, 43
Dogfish, 33
Dogs, 274
*doliata* (*Lampropeltis*), 221
Dolly Varden trout, 49
dolomieu (Macropterus), 121
Dormitator, 142
Dorosoma, 35
Dorosomidæ, 35
dorsalis (Chrysemys marginata), 246
(Dipsosaurus), 194
(Eutamias), 343
(Plethodon), 158
(Triturus), 154
dorsatum (Erethizon), 335
douglasi (Citellus grammurus), 348
(Sciurus), 339
(Sciurus douglasi), 339
(Thomomys), 327
douglassi (Phrynosoma), 201
(Phrynosoma douglassi), 202
*draeonoides* (*Callisaurus*), 195
draytoni (Rana), 183
Drums, 138
Drymarchon, 219
dulcis (Leptotyphlops), 211
(Rhinichthys cataractæ), 86
duquesnei (Placopharynx), 61
Dusky salamander, 158
dutcheri (Microtus), 318
Dwarf salamander, 164
dychei (Reithrodontomys megalotis), 303

Eastern harvest mouse, 302
edax (Microtus), 317
Edentata, 256
edwardsi (Sistrurus catenatus), 232
Eel cat, 93
Eels, 51
effulgens (Boleosoma nigrum), 130
egregius (Leuciscus), 70
(Plestiodon), 207
Elaphe, 217
Elaphidæ, 230
Elaphine snakes, 208, 230
*Elaps*, 230
elapsoides (Lampropeltis), 222
Elassoma, 114
Elassomidæ, 114
elator (Dipodomys), 333
elegans (Arizona), 220
(Citellus), 348
(Gila), 69
(Holbrookia), 196
(Pseudemys), 247
*elegans* (*Thamnophis*), 229
elegans(Virginia), 227
Eleutherodactylus, 174
eleutherus (Schilbeodes), 97
Elk, 363
elongata (Mephitis), 289
elongatus (Cycleptus), 55
(Leuciscus), 71
elucus (Procyon lotor), 280
Embiotocidæ, 139
emiliæ (Opsopœodus), 73
emoryi (Amyda), 249
Emys, 242
energumenos (Putorius vison), 287
engelhardti (Marmota flaviventris), 351
Enneacanthus, 117
Ensatina, 159
ensatus (Dicamptodon), 149
Entosphenus, 26
eos (Chrosomus), 66
ephippicus (Chilomeniscus), 224
episcopa (Hybognathus), 67
(Sonoia), 223
epixanthum (Erethizon), 336
Eptesicus, 270
erebennus (Ameiurus), 94
eremicus (Lepus californicus), 357
(Lynx ruffus), 295
(Odocoileus hemionus), 365
(Peromyscus), 308
(Sigmodon hispidus), 310
Erethizon, 335
Erethizontidæ, 335
Eretmochelys, 250
Ericymba, 85

eriensis (Leucichthys), 40
Erimyzon, 59
erythrogaster (Chrosomus), 66
erythrogrammus (Abastor), 213
Esocidae, 98
Esox, 98
estor (Canis), 276
(Mephitis), 289
Etheostoma, 131
Eublepharidæ, 193
Eucalia, 110
Euderma, 272
*Eumeces*, 205
Eumetopias, 296
Eupomotis, 119
European carp, 64
trout, 49
Eurycea, 163
euryorus (Eupomotis), 120
eurystomus (Notropis), 79
euryxanthus (Micrurus), 230
*Eutænia*, 227
Eutamias, 343
Even-toed ungulates, 361
Eventognathi, 51
evergladei (Elassoma), 114
evermanni (Hadropterus), 125
evides (Hadropterus), 126
evittata (Hyla), 177
evotis (Myotis), 269
Evotomys, 320
exilicauda (Lavinia), 66
exilis (Dipodomys merriami), 332
(Schilbeodes), 96
Exocœtidæ, 108
Exoglossum, 91
extenuatum (Stilosoma), 222
extimus (Sciurus carolinensis), 340
Eyra, 294

falcata (Agosia), 87
fallax (Neotoma mexicana), 312
(Perognathus), 330
Fallfish, 68
Fan-tailed darter, 135
Farancia, 213
*fasciata* (*Natrix*), 225
(Natrix sipedon), 226
fasciatus (Achirus), 143
(Lynx), 295
(Lynx fasciatus), 295
(Perognathus), 329
(Plestiodon), 206
fasciolaris (Notropis umbratilis), 84
Fathead, 67
fatuus (Synoptomys), 320
Felidæ, 293
Felis, 293
Felis catus, 293
domestica, 293
maniculata, 293
femoralis (Hyla), 177
(Perognathus), 330
Fence lizard, 198
feriarum (Pseudacris), 178
ferox (Amyda), 250
ferreus (Aneides), 160
(Sciurus aberti), 341
Fiber, 322
Ficimia, 224
Field mice, 313
Fine-scaled suckers, 55
Fisher, 282
Fishes, 15
fisheri (Citellus grammurus), 348
(Sorex), 263
(Thomomys quadratus), 327
flabellare (Etheostoma), 135
flagellum (Coluber), 217
flammeus (Leuciscus), 71
Flatheaded chub, 90
flavescens (Kinosternon), 238
(Perca), 122
(Perognathus), 329
flavilatus (Leimadophis), 220
flavissimus (Pseudotriton montanus), 162
flaviventris (Coluber constrictor), 217
(Marmota), 351
(Marmota flaviventris), 351
flavus (Bassariscus astutus), 280
(Noturus), 95
(Perognathus), 329
Florida cougar, 294
white tail, 364
floridæ (Jordanella), 105
floridana (Cryptotis), 265
(Lampropeltis getulus), 221
(Neotoma), 311
(Neotoma floridana), 311
(Pseudemys), 248
(Rhineura), 208
floridanus (Canis), 275
(Dasypterus), 271
(Geomys tuza), 324
(Lynx ruffus), 295
(Peromyscus), 308
(Sylvilagus), 357
(Sylvilagus floridanus), 358

floridanus (Urocyon cinereoargenteus), 278
(Ursus americanus), 274
floripinnis (Fundulus), 103
fluviatilis (Lampetra), 27
Flying squirrels, 352
fonticola (Microperca), 136
fontigenus (Microtus pennsylvanicus), 316
fontinalis (Salvelinus), 48
(Sorex), 261
formosa (Heterandria), 106
formosus (Perognathus), 330
formulosum (Compostoma), 65
fossor (Thomomys), 327
Four-spined stickleback, 111
fowleri (Bufo), 171
Fox-snake, 219
Fox squirrel, 341
Foxes, 274
franklini (Citellus), 347
frater (Eutamias), 344
fremonti (Sciurus), 338
(Sciurus fremonti), 338
Fresh-water sculpins, 139
Frogs, 166, 179
frondator (Castor canadensis), 354
frontale (Phrynosoma blainvilli), 201
Frostfish, 38
frustror (Canis), 275
fuliginosus (Sciuropterus alpinus), 353
(Scuirus carolinensis), 340
fulva (Vulpes), 277
fulvescens (Reithrodontomys), 303
fulvius (Micrurus), 230
fulvus (Thomomys), 326
(Thomomys), 326
fumeus (Sorex), 262
Fundulus, 100
Fur seal, 297
furcatus (Ictalurus), 92
furiosus (Schilbeodes), 96
fusca (Desmognathus), 155
(Desmognathus fusca), 155
(Neotoma cinerea), 313
fuscipes (Neotoma), 312
(Neotoma fuscipes), 313
fuscogriseus (Onychomys leucogaster), 301
fuscus (Eptesicus), 270
(Eptesicus fuscus), 270
(Thomomys), 328
(Thomomys fuscus), 328
fusiformis (Boleichthys), 136
fusus (Peromyscus leucopus), 307
Gadidæ, 142
gaillardi (Ovis canadensis), 367
gairdneri (Salmo), 45
galacturus (Notropis), 80
galei (Evotomys gapperi), 321
gambeli (Peromyscus maniculatus), 305
Gambusia, 105
Ganoid fishes, 28
Ganoidei, 28
gapperi (Evotomys), 321
(Evotomys gapperi), 321
Garfish, 108
Garpikes, 32, 108
Garter snakes, 227
Gasterosteidæ, 109
Gasterosteus, 109
Gastrophryne, 184
Geckos, 193
Gekkonidæ, 193
geldius (Hybopsis), 89
generosus (Pantosteus), 55
gentilis (Lampropeltis triangulum), 222
geographica (Graptemys), 244
Geomyidæ, 323
Geomys, 323
Gerrhonotus, 202
getulus (Lampropeltis), 221
(Lampropeltis getulus), 221
Giant salamanders, 148
gibbosus (Eupomotis), 120
gibbsi (Neurotrichus), 260
(Salmo), 44
gigas (Canis), 275
(Lynx), 295
Gila, 69
Gila monster, 204
gilberti (Notropis), 78
(Peromyscus truei), 308
(Salmo), 47
(Schilbeodes), 97
Gizzard shad, 35
Glass snake, 203
gloriosus (Enneacanthus), 117
glutinosa (Myxine), 24
glutinosus (Plethodon), 158
Glutton, 283
Goats, 366
Gobies, 142
Gobiidæ, 142
Gobioidei, 142
Golden chipmunks, 345
mouse, 308
shiner, 73
trout, 47

Goldfish, 64
goldmani (Perodipus), 332
goodei (Lucania), 105
Gopher snake, 219
frog, 182
turtle, 248
Gopherus, 248
Gophers, 346, 347
gorbuscha (Oncorhynchus), 43
gossypinus (Peromyscus), 307
(Peromyscus gossypinus), 307
Goujon, 95
gracilis (Eutamias quadrivittatus), 344
(Peromyscus maniculatus), 305
(Platygobio), 90
(Spilogale), 291
(Tantilla), 229
(Uranidea), 142
graciosa (Uta), 197
graciosus (Sceloporus), 199
grahamensis (Sciurus fremonti), 339
grahami (Cnemidophorus), 205
(Natrix), 225
grahamiæ (Salvadora), 216
grammurus (Citellus), 348
grandis (Ptychocheilus), 69
grangeri (Sylvilagus nuttalli), 358
Graptemys, 244
Grass pike, 99
snake, 216
Grasshopper mice, 300
gratiosa (Hyla), 177
Gray foxes, 278
rabbit, 357
seal, 297
squirrel, 340
wolf, 275
Graylings, 49
Great forked-tail cat, 92
Great Lakes catfish, 94
trout, 47
Green-back, 45
Green-sided darter, 129
Green-frog, 181
snake, 216
sturgeon, 31
sunfish, 118
turtle, 251
Greenback, 47
greeni (Couesius), 90
Gridiron-tailed lizard, 195
grinnelli (Scapanus latimanus), 260
grisescens (Myotis), 268
griseum (Stizostedion canadense), 123
griseus (Castostomus), 56
(Sciurus), 340
(Sciurus griseus), 340
(Tamias striatus), 342
Grizzly bear, 274
Ground-hogs, 350
Ground rattler, 232
snake, 213
squirrels, 346
grœnlandica (Phoca), 297
grunneus (Aplodinotus), 138
grylio (Rana), 183
gryllus (Acris), 178
grypus (Halichærus), 297
gularis (Cnemidophorus), 204
Gulo, 282
gulosus (Chænobryttus), 117
(Cottus), 140
gunnisoni (Cynomys), 350
guttata (Clemmys), 240
(Elaphe), 218
guttatus (Fundulus), 103
(Percopsis), 111
guttolineata (Eurycea), 164
guttulatus (Plestiodon), 207
gymnicus (Sciurus hudsonicus), 338
Gyrinophilus, 162
gyrinus (Schilbeodes), 96

Hadropterus, 124
Hagfish, 24
Hairy-tailed mole, 258
*Haldea*, 227
Halichærus, 297
halicœtes (Reithrodontomys raviventris), 303
halophilus (Bufo boreas), 174
hammondi (Scaphiopus), 169
(Thamnophis), 229
Haplomi, 97
Harbor seal, 297
Harelip sucker, 61
harengus (Leucichthys), 40
Hares, 354
Harlequin snake, 230
Harp seal, 297
harrisi (Ammospermophilus), 346
Harvest mice, 301
mouse, 302
Hawk bill, 250
haydeni (Microtus), 316
hayi (Hybognathus), 67
Hedgehog, 335
helaletes (Synaptomys), 320

Hellbender, 148
Heloderma, 204
Helodermatidæ, 204
Hemibranchii, 109
Hemidactylium, 159
Hemidactylus turcicus, 193
hemionus (Odocoileus), 365
hemiophrys (Bufo), 172
henshalli (Fundulus), 103
henshawi (Salmo), 45
(Xantusia), 204
hernandesi (Felis), 294
(Phrynosoma), 202
hernandezi (Procyon lotor), 280
Heros, 139
heros (Eupomotis), 120
Herring, 36
hesperis (Uta stansburiana), 197
Hesperoleucus, 72
hesperus (Pipistrellus), 270
(Thomomys), 328
Heterandria, 106
heteroclitus (Fundulus), 101
Heterodon, 214
heterodon (Notropis), 77
Heterognathi, 91
Heteromyidæ, 328
Heterostomata, 143
hindsi (Eutamias), 343
Hiodon, 34
Hiodontidæ, 34
hippocrepis (Kinosternon subrubrum), 238
hippolestes (Felis oregonensis), 294
hispida (Phoca), 297
hispidus (Perognathus), 330
(Sigmodon), 310
(Sigmodon hispidus), 310
histrio (Ulocentra), 128
Hitch, 66
Hoary bat, 271
Hog-nosed skunk, 291
snakes, 214
Hog sucker, 57
holbrooki (Eupomotis), 120
(Lampropeltis getulus), 221
(Scaphiopus), 169
Holbrookia, 196
Holconoti, 139
Holostei, 31
holzneri (Mephitis occidentalis), 290
(Sylvilagus floridanus), 358
Hoofed animals, 361
Hoop snake, 217
Horn snake, 214
Horned dace, 68
lizards, 200
pout, 94
toads, 200
Horny-head, 90
Horny-heads, 87
horriæus (Ursus horribilis), 274
horribilis (Ursus), 274
(Ursus horribilis), 274
horridus (Crotalus), 233
House-bat, 270
House-mouse, 299
howelli (Scalopus aquaticus), 258
hoyi (Leucichthys), 41
(Microsorex), 264
hudsonica (Mephitis), 289
hudsonicus (Sciurus), 338
(Sciurus hudsonicus), 338
hudsonius (Notropis), 78
(Zapus), 334
(Zapus hudsonius), 334
hulophaga (Blarina brevicauda), 265
Humpback salmon, 43
humeralis (Nycticeius), 272
humilis (Lepomis), 119
(Siagonodon), 211
humulis (Reithrodontomys), 301
(Reithrodontomys humulis), 302
huronis (Leucichthys), 40
hurteri (Scaphiopus), 170
hyacinthinus (Neurotrichus gibbsi), 260
Hybognathus, 66
Hybopsis, 87
Hydromantes, 164
hydrophlox (Leuciscus), 69
Hyla, 175
Hylidæ, 174
hyostomus (Hybopsis), 88
Hyperoartii, 24
Hyperotreti, 24
Hypohomus, 126
Hypopachus, 184
hypophæus (Sciurus carolinensis), 340
hypselopterus (Notropis), 80
Hypsiglena, 223
hypsinotus (Hybopsis), 89
Hysterocarpus, 139

Ichthyomyzon, 25
Ichthyopsida, 13
ictalops (Cottus), 141
Ictalurus, 92
Ictiobus, 52
idahoensis (Brachylagus), 360

idahoensis (Evotomys), 321
iecanus (Aneides), 160
illecebrosus (Notropis), 79
illinoensis (Neotoma floridana), 311
imbricata (Eretmochelys), 250
immaculatus (Esox masquinongy), 99
impiger (Reithrodontomys humulis), 302
incautus (Myotis), 268
inconstans (Eucalia), 111
indianola (Spilogale), 290
Indigo snake, 219
infernalis (Gerrhonotus), 203
ingens (Perodipus), 332
inornatus (Amphiardis), 227
insculpta (Clemmys), 240
Insectivora, 256
insignis (Napæozapus), 335
(Schilbeodes), 96
intermedia (Neotoma), 313
intermedius (Dasypterus), 271
(Perognathus), 330
(Plethodon), 159
(Reithrodontomys fulvescens), 303
(Scalopus aquaticus), 258
interpres (Ammospermophilus), 346
interrupta (Morone), 137
(Spilogale), 290
interruptus (Archoplites), 116
inyoensis (Urocyon cinereoargenteus), 278
Ioa, 131
iowæ (Etheostoma), 134
Iguanas, 193
Iguanidæ, 193
irideus (Salmo), 46
Isospondyli, 34

Jack rabbit, 356
Jackal, 275
Jaguar, 294
Jaguarundi cat, 294
jamaicensis parvipes (Artibus), 267
jarrovi (Sceloporus), 199
jeffersonianum (Ambystoma), 151
jejunus (Notropis), 82
Jerker, 90
jessiæ (Etheostoma), 134
Johnny darter, 130
Jordanella, 105
jordani (Etheostoma), 134
(Pantosteus), 55
(Plethodon), 159
(Salmo), 45
jubata (Eumetopias), 296
Jumbo herring, 40
Jumping mice, 333

kaibabensis (Sciurus), 341
kamloops (Salmo), 46
kanawha (Notropis), 78
Kangaroo mice, 333
rats, 331
Keel-backed lizard, 194
kempi (Caretta), 251
kentuckiensis (Hybopsis), 90
kernensis (Dipodomys merriami), 332
keta (Oncorhynchus), 43
Killifish, 100
King salmon, 43
King-snakes, 220
Kinosternidæ, 237
Kinosternon, 237
kirtlandi (Natrix), 225
kisutch (Oncorhynchus), 43
Kit fox, 277
klamathensis (Cottus), 141
(Lepus washingtoni), 356
(Sciuropterus alpinus), 353
kohni (Graptemys pseudogeographicus), 245

Labidesthes, 113
labrosus (Hybopsis), 89
lacera (Logochila), 61
lacerata (Holbrookia), 196
Lacertilia, 191
lacertina (Siren), 166
lacustris (Ameiurus), 94
læta (Elaphe), 218
Lagurus, 318
Lake herring, 39
sturgeon, 30
trout, 48
lamottenii (Lampetra), 27
Lampetra, 27
Lampreys, 24
Lampropeltis, 220
Land tortoises, 248
turtles, 239
Large-mouthed black bass, 121
Larvæ of Plethodontidae, 165
lascivus (Sciuropterus alpinus), 353
Lasionycteris, 269
*Lasiurus*, 271
Latax, 292
lataxina (Lutra canadensis), 292
laterale (Leiolopisma), 207
lateralis (Callospermophilus), 345

lateralis (Coluber), 217
(Mylocheilus), 68
laticeps (Thomomys bottæ), 325
latifrons (Spilogale phenax), 291
latimanus (Phenacomys), 320
(Scapanus), 260
(Scapanus latimanus), 260
latipinna (Mollienisia), 106
latipinnis (Catostomus), 56
latirostris (Trichechus), 256
latrans (Canis), 276
(Eleutherodactylus), 174
Lavinia, 65
Lawyer, 142
Leaf-nosed bats, 266
Least weasel, 285
Leather-turtle, 251
lecontei (Rhinocheilus), 223
Leimadophis, 220
Leiolopisma, 207
Leopard frog, 180
lizard, 195
Lemmings, 313, 319
lepida (Neotoma), 312
(Neotoma lepida), 312
*Lepidosteus*, 32
lepidus (Crotalus), 234
Lepisosteidæ, 32
Lepisosteus, 32
Lepomis, 118
Leporidæ, 354
Leposternidæ, 207
leptacanthus (Schilbeodes), 97
Leptocephali, 51
Leptops, 95
Leptotyphlopidæ, 211
Leptotyphlops, 211
leptus (Putorius streatori), 285
Lepus, 355
*Lepus sylvaticus*), 357
lestes (Canis), 276
Leucichthys, 39
leuciodus (Notropis), 83
Leuciscus, 69
leucodon (Thomomys bottæ), 325
leucogaster (Onychomys), 300
(Onychomys leucogaster), 300
leucogenys (Sorex), 263
leucoparia (Spilogale), 291
leucopus (Peromyscus), 306
(Peromyscus leucopus), 306
leucotis (Sciurus carolinensis), 340
leucurus (Ammospermophilus), 346
(Cynomys), 350
Leurognathus, 157
levis (Ochotona), 361
(Uta), 198
lewisi (Salmo), 44
Lichanura, 211
limi (Umbra), 97
linearis (Uta ornata), 198
lineatum (Tropidoclonion), 226
lineatus (Fundulus), 102
(Leuciscus), 70
(Roccus), 137
lineolatum (Etheostoma flabellare), 135
Ling, 142
Liodytes, 229
Liopeltis, 216
liorus (Chasmistes), 58
lirus (Notropis), 84
Little brown bat, 268
pickerel, 99
sunfish, 117
littoralis (Malaclemys pileata), 244
(Sigmodon hispidus), 310
(Sylvilagus aquaticus), 360
(Urocyon), 279
Lizards, 191
Lobo, 275
Log-perch, 124
Loggerhead turtle, 251
Logochila, 61
Long-eared bat, 269
fox, 278
sunfish, 119
Long-nose sucker, 56
Long-tailed shrews, 261
skunk, 289
weasel, 283, 285
longicauda (Eurycea), 164
longicaudus (Microtus), 316
(Onychomys torridus), 301
(Phenocomys), 320
(Putorius), 285
(Putorius longicaudus), 285
(Reithrodontomys megalotis), 303
(Sorex), 262
longicrus (Myotis lucifugus), 268
longimanus (Boleosoma), 129
longimembris (Perognathus), 330
longipes (Onychomys leucogaster), 301
(Perodipus), 332
longirostris (Sorex), 263
lordi (Perognathus), 330
Loricati, 139
loringi (Evotomys gapperi), 321
loquax (Sciurus hudsonicus), 338

Lota, 142
lotor (Procyon), 279
(Procyon lotor), 280
louisianæ (Odocoileus americanus), 364
Lucania, 104
lucifuga (Eurycea), 164
lucifugus (Myotis), 268
(Myotis lucifugus), 268
lucius (Esox), 98
(Ptychocheilus), 69
ludovicianus (Cynomys), 349
(Cynomys ludovicianus), 160
(Microtus), 316
lugubris (Aneides), 160
luscus (Gulo), 283
luteiventris (Eutamias quadrivittatus), 344
luteola (Marmota flaviventris), 351
luteolus (Ursus), 274
luteovinctum (Etheostoma), 134
lutescens (Geomys), 324
luteus (Peromyscus maniculatus), 306
lutipinnis (Notropis), 82
Lutra, 292
lutrensis (Notropis), 78
lutreocephalus (Putorius vison), 287
Lutrinæ, 292
lutris (Latax), 292
luxatus (Chasmistes), 58
Luxilinus, 72
lycaon (Canis), 275
lychnuchus (Sciurus fremonti), 338
Lyciscus, 275
lyelli (Sorex tenellus), 263
Lynx, 294
lyrophanes (Trimorphodon), 230
lysteri (Tamias striatus), 342
lythrurus (Notropis umbratilis), 84

macdonaldi (Fundulus), 102
(Notropis), 81
(Salmo), 45
machrinoides (Scalopus aquaticus), 258
machrinus (Scalopus aquaticus), 258
Mackinaw trout, 48
macrocephalus (Hadropterus), 125
macrocheilus (Catostomus), 57
Macrochelys, 239
macrochirus (Lepomis), 119
macrodactylum (Ambystoma), 152
macrodon (Fiber zibethicus), 322
macrolepidotus (Pogonichthys), 68
macropterus (Centrarchus), 115
macropus (Microtus richardsoni), 318
macrospilota (Malaclemys pileata), 244
macrospilotus (Citellus spilosoma), 347
macrostomus (Notropis), 79
macrotis (Corynorhinus), 272
(Corynorhinus macrotis, 272
(Neotoma fuscipes), 313
(Sciuropterus sabrinus), 353
(Vulpes), 278
Macrotus, 267
macroura milleri (Mephitis), 290
macrourus (Odocoileus americanus), 364
(Vulpes), 277
macrurus (Microtus), 317
maculata (Holbrookia), 196
maculaticeps (Boleosoma nigrum), 130
maculatum (Ambystoma), 150
(Etheostoma), 133
(Euderma), 272
maculatus (Dormitator), 142
*maculicauda* (*Eurycea*), 164
maculosa (Lota), 142
maculosus (Necturus), 147
Mad-toms, 95
magruderensis (Perognathus parvus), 330
Mailed-cheek fishes, 139
major (Aplodontia), 336
(Batracoseps), 161
(Citellus spilosoma), 347
(Mephitis occidentalis), 290
(Terrapene), 243
Malaclemys, 243
mallurus (Sylvilagus floridanus), 358
Mammalia, 14, 252
maniculatus (Peromyscus), 305
(Peromyscus maniculatus), 305
Manitee, 256
manitoulinus (Leucichthys), 41
Map turtles, 244
Marbled salamander, 150
marcianus (Thamnophis), 229
margarita (Leuciscus), 71
marginata (Chrysemys), 245
(Chrysemys marginata), 246
marginatum (Stereochilus), 161
Marine turtles, 250, 251
marinus (Petromyzon), 26
(Tylosurus), 108, 251
marmorata (Clemmys), 241
(Leurognathus), 157
marmoratus (Ameiurus nebulosus), 94
Marmota, 350
Marmots, 336
marnocki (Syrrhophus), 174
Marsh rabbit, 360
rat, 309

Marsh shrew, 263
Marsipobranchii, 24
Marsupialia, 254
Martens, 281
*Martes*, 281
martirensis (Peromyscus truei), 308
masoni (Salmo), 46
masquinongy (Esox), 99
Massasauga, 232
matutinus (Notropis umbratilis), 84
maxillingua (Exoglossum), 91
mazama (Evotomys), 321
(Thomomys monticola), 327
m'calli (Phrynosoma), 202
Meadow jumping-mouse, 334
mice, 313
means (Amphiuma), 148
mearnsi (Canis), 276
(Sylvilagus floridanus), 358
(Uta), 197
Meantes, 166
medirostris (Acipenser), 31
meeki (Hybopsis), 88
megacephalus (Microdipodops), 333
(Peromyscus gossypinus), 307
Megachiroptera, 266
megalophylla senicula (Mormoops), 267
megalotis (Lepomis), 119
(Reithrodontomys), 302
(Reithrodontomys megalotis), 302
melanoleucus (Pituophis), 219
melanophrys (Onychomys leucogaster), 301
melanopleura (Eurycea), 164
melanops (Minytrema), 59
melanopterus (Eptesicus fuscus), 271
melanostethus (Cnemidophorus), 205
melanotis (Lepus californicus), 357
melas (Ameiurus), 94
Melinæ, 291
Menhaden, 36
Menidia, 112
Menominee whitefish, 38
menona (Fundulus diaphanus), 102
Mephitinæ, 287
Mephitis, 287
mephitis (Mephitis), 289
mergens (Fiber zibethicus), 322
meridionalis (Triturus), 154
merriami (Cervus canadensis), 363
(Dipodomys), 332
(Dipodomys merriami), 332
(Eutamias), 343
(Lepus californicus), 357
(Perognathus), 329
merriami (Reithrodontomys humulis), 302
Mesogonistius, 117
mesoleucus telmalestes (Conepatus), 291
mesomelas (Mephitis), 289
(Mephitis mesomelas), 289
metallicus (Notropis), 84
metcalfi (Plethodon), 159
mewa (Thomomys bottæ), 326
Mexican bat, 273
mexicana (Neotoma), 312
(Neotoma mexicana), 312
(Ovis), 368
mexicanus parvidens (Citellus), 349
Procyon lotor), 280
Mice, 298
Michigan grayling, 49
microcephalus (Gasterosteus williamsoni), 110
Microchiroptera, 266
Microdipodops, 333
microdon (Canis), 276
microlepidotus (Orthodon), 65
Microperca, 136
microps (Catostomus), 58
(Perodipus), 332
Micropterus, 120
micropteryx (Notropis), 83
micropus (Neotoma), 311
Microsorex, 264
microstomum (Ambystoma), 152
Microtinæ, 313
Microtus, 314
Micrurus, 230
miliarius (Sistrurus), 232
Milk-snake, 221
Miller's thumb, 141
mimus (Sciurus aberti), 341
miniatus (Lepomis), 119
minimus (Eutamias), 344
Mink, 285
frog, 183
minnesota (Sciurus hudsonicus), 338
Minnows, 61
minor (Microtus), 317
(Sylvilagus auduboni), 359
(Thomomys bottæ), 325
minusculus (Scapanus latimanus), 260
Minytrema, 59
mirabilis (Phenacobius), 85
mississippiensis (Alligator), 190
Missouri sucker, 55
missouriensis (Onychomys leucogaster), 300
mitchelli (Crotalus), 234

mitrulus (Hesperoleucus), 72
miurus (Schilbeodes), 96
mniotiltus (Catostomus), 57
mobilensis (Geomys tuza), 324
Moccasin, 231
modestum (Phrynosoma), 201
modestus (Microtus pennsylvanicus), 316
mogollonensis (Microtus), 318
(Sciurus fremonti), 339
mohavensis Citellus), 349
mokasen (Agkistrodon), 231
Mole salamander, 150
shrew, 264
Moles, 257
Mollienisia, 106
mollipilosus (Perognathus parvus), 330
(Sciurus douglasi), 339
mollis (Citellus), 349
Molossidæ, 272
molossus (Crotalus), 233
monacus (Hybopsis), 89
monax (Marmota), 350
(Marmota monax), 351
Montana grayling, 49
montanus (Hybopsis), 89
(Microtus), 317
(Oreamnos), 368
(Perodipus), 331
(Pseudotriton), 162
(Pseudotriton montanus), 162
(Rangifer), 366
(Thymallus), 49
(Zapus), 335
montereyensis (Sorex), 262
monticola (Desmognathus), 157
(Sorex vagrans), 262
(Thomomys), 327
(Thomomys monticola), 327
Moon-snake, 224
Mooneyes, 34
Moose, 365
mordax (Microtus), 317
(Osmerus), 50
Mormoops, 267
Morone, 137
morroensis (Perodipus), 332
mortivallis (Dipodomys merriami), 333
Mountain beavers, 336
boomer, 195
coyote, 276
goat, 368
lemming, 320
lion, 294
sheep, 367
Mountain suckers, 55
rats, 310
wildcat, 295
Moxostoma, 59
mucosa (Rana boyli), 183
Mud cat, 95
eel, 166
minnows, 97
shad, 35
snake, 214
sunfish, 115
turtles, 237
Mudpuppy, 147
muhlenbergi (Clemmys), 242
Mule-deer, 365
Mullets, 51
multiplicata (Eurycea), 164
multivirgatus (Plestiodon), 207
Mummichog, 101
mundus (Putorius xanthogenys), 285
Muridæ, 298
Murinæ, 299
Mus, 299
Muscalonge, 99
musculus (Mus), 299
Musk turtles, 237
Muskallunge, 99
Muskhog, 362
Muskrats, 322
Mustela, 281
*Mustela*, 283
Mustelidæ, 280
Mustelinæ, 281
Mutabilia, 147
mutica (Amyda), 249
(Vulpes), 277
multicincta (Lampropeltis), 222
mydas (Chelonia), 251
Mylocheilus, 68
Mylopharodon, 68
myops (Sorex tenellus), 263
Myotis, 268
Myxine glutinosa, 24

nachtriebi (Leuciscus), 71
namaycush (Cristivomer), 48
nannodes (Cervus canadensis), 363
nanus (Microtus), 318
(Sorex tenellus), 263
Napæozapus, 335
narica pallida (Nasua), 280
Narrow-mouthed toads, 184
nascius (Heterodon), 215
Nasua, 280

natalis (Ameiurus), 94
Natrix, 224
navarroensis (Hesperoleucus), 72
navigator (Neosorex), 263
navus (Thomomys bottæ), 326
nebracensis (Canis), 276
(Canis nebracensis), 276
nebrascensis (Peromyscus maniculatus), 306
nebulosus (Ameiurus), 94
necator (Vulpes), 277
Necturus, 147
neglecta (Taxidea taxus), 292
neglectus (Citellus), 348
(Eutamias quadrivittatus), 344
(Sciurus niger), 342
nelsoni (Ammospermophilus), 346
(Ovis), 367
Nematognathi, 91
nemoralis (Pitymys), 319
Neofiber, 319
neogæus (Leuciscus), 71
neomexicanus (Sciurus fremonti), 339
(Sylvilagus auduboni), 359
Neoseps, 207
Neosorex, 263
Neotoma, 310
Neotominæ, 310
nerka (Oncorhynchus), 43
Neurotrichus, 260
nevadensis (Agosia), 87
(Dipodomys merriami), 333
(Sorex), 262
Newts, 153
niger (Leuciscus), 70
(Sciurus), 341
(Sciurus niger), 342
Nigger chub, 91
nigra (Lampropeltis getulus), 221
nigrans (Microtus pennsylvanicus), 316
nigrescens (Reithrodontomysmegalotis), 303
nigricans (Catostomus), 57
nigrilabris (Ameiurus), 95
nigripes (Putorius), 287
(Sciurus griseus), 340
nigripinnis (Leucichthys), 41
nigrita (Pseudacris), 179
nigrofasciatus (Hadropterus), 126
nigrum (Boleosoma, 130
niloticus (Crocodylus), 190
Nine-banded armadillo, 256
nitidus (Pseudotriton ruber), 163
nitratoides (Dipodomys merriami), 333
nitratus (Dipodomys merriami), 333
nivaria (Marmota caligata), 352
nivarius (Evotomys), 322
niveiventris (Peromyscus polionotus), 306
nobilis (Gerrhonotus), 203
nocomis (Notropis), 78
noctivagans (Lasionycteris), 269
nocturnus (Schilbeodes), 97
norvegicus (Mus), 299
nosophora (Marmota flaviventris), 351
notata (Mephitis occidentalis), 290
(Uma), 196
notatus (Fundulus), 104
(Notropis), 79
(Pimephales), 67
(Sphærodactylus), 193
Notiosorex, 265
notius (Putorius noveboracensis), 284
Notropis, 74
notti (Fundulus), 103
Noturus, 95
noveboracensis (Peromyscus leucopus), 307
(Putorius), 283
(Putorius noveboracensis), 284
novemcinctus (Dasypus), 256
nubila (Agosia), 87
(Hybognathus), 67
nubilus (Canis), 275
nubiterræ (Peromyscus maniculatus), 305
nuchalis (Hybognathus), 67
nuttalli (Peromyscus), 308
(Peromyscus nuttalli), 308
(Sylvilagus), 358
(Sylvilagus nuttalli), 358
Nycteris, 271
Nycticeius, 271
Nyctinomus, 272
Nyctophilinæ, 272

obesus (Enneacanthus), 117
(Sauromalus), 194
obscura (Marmota flaviventris), 352
obscurus (Evotomys), 321
(Pipistrellus subflavus), 270
(Sorex), 262
obsoleta (Elaphe), 218
(Elaphe obsoleta), 218
obsoletus (Citellus), 348
(Plestiodon), 206
*occidentalis* (*Canis*), 275
occidentalis (Catostomus), 57
(Cervus canadensis), 363
(Evotomys), 322
(Heterandria), 106
(Luxilinus), 72
(Mephitis), 289

occidentalis (Mephitis occidentalis), 289
(Neotoma cinerea), 313
(Pseudacris), 179
(Sceloporus), 200
occipitalis (Fiber zibethicus), 322
(Sonora), 223
occipitomaculata (Storeria), 227
occisor (Putorius), 284
occultus (Myotis), 268
(Scapanus latimanus), 260
Ocelot, 294
Ochotona, 360
Ochotonidæ, 360
ochraceus (Evotomys gapperi), 321
(Peromyscus leucopus), 307
ochrogaster (Microtus), 316
ochrophæa (Desmognathus), 157
(Desmognathus ochrophæa), 157
ochropus (Canis), 276
ochrorhynchus (Hypsiglena), 223
ochrus (Perognathus californicus), 331
ocius (Thomomys), 327
ocularis (Pseudacris), 179
oculeus (Lynx fasciatus), 296
oculifera (Graptemys pseudogeographica), 245
ocythous (Urocyon cinereoargenteus), 278
Odocoileus, 363
odoratum (Kinosternon), 237
ohiensis (Alosa), 37
(Esox masquinongy), 99
Old world rats and mice, 299
olivaceus (Citellus tridecemlineatus), 347
oliva (Perognathus parvus), 330
oliva (Rutilus), 72
olivaris (Leptops), 95
olmstedi (Boleosoma nigrum), 130
olympica (Aplodontia), 336
(Spilogale phenax), 291
olympicus (Phenacomys), 320
(Ryacotriton), 149
(Sciuropterus alpinus), 353
olympus (Marmota caligata), 352
ommata (Lucania), 104
onca (Rana), 183
Oncorhynchus, 42
*Ondatra*, 322
ontariensis (Leucichthys), 40
Onychomys, 300
opacum (Ambystoma), 150
Opheodrys, 216
Ophisaurus, 203
Opisthoglyph snakes, 208, 211
Opossums, 255
Opsopœodus, 72
oquassa (Salvelinus), 49
orarius (Scapanus), 260
(Scapanus orarius), 260
(Zapus), 335
orcutti (Leuciscus), 71
ordi (Perodipus), 332
ordinoides (Thamnophis), 229
Oreamnos, 368
oreas (Chrosomus), 66
(Peromyscus maniculatus), 305
oregonensis (Felis), 294
(Felis oregonensis), 294
(Putorius xanthogenys), 285
(Ptychocheilus), 69
(Rutilus), 72
(Sciuropterus alpinus), 353
oregoni (Microtus), 318
oregonus (Bassariscus astutus), 280
(Coregonus), 39
(Crotalus), 234
(Zapus princeps), 334
origenes (Mustela caurina), 282
ornata (Pseudacris), 179
(Terrapene), 243
(Uta), 198
(Uta ornata), 198
ornatissimum (Phrynosoma), 202
ornatum (Campostoma), 65
(Phrynosoma douglassi), 202
ornatus (Sorex), 262
orophilus (Phenacomys), 320
Orthodon, 65
oryzivorus (Oryzomys palustris), 310
Oryzomys, 309
osceola (Chelydra), 239
(Eptesicus fuscus), 270
(Odocoileus), 364
oscula (Agosia), 87
osmeriformis (Leucichthys), 40
Osmerus, 50
osoyoosensis (Fiber zibethicus), 322
osseus (Lepisosteus), 32
Otariidæ, 296
Otters, 280, 292
ouachitæ (Hadropterus), 125
ouananiche (Salmo salar), 44
Ovis, 367
*oxyrhynchus* (*Acipenser*), 30

Pacific marten, 282
salmon, 42
tree frog, 178
wildcat, 295

pacifica (Aplodontia), 336
(Lutra canadensis), 292
(Mustela pennanti), 282
(Procyon psora), 280
pacificus (Batrachoseps), 161
(Castor canadensis), 354
(Sorex), 263
(Thaleichthys), 50
(Zapus), 335
Paddle-fishes, 29
Painted turtles, 245
Painter, 294
pallescens (Corynorhinus macrotis), 272
(Lynx fasciatus), 295
(Peromyscus maniculatus), 306
pallidus (Antrozous), 272
(Citellus tridecemlineatus), 347
(Eupomotis), 120
(Eutamias), 345
(Fiber zibethicus), 322
(Lagurus), 318
(Lepomis), 119
(Microdipodops), 333
(Procyon), 280
palmarius (Peromyscus gossypinus), 307
palmeri (Gerrhonotus), 203
(Neosorex bendiri), 264
paludicola (Sylvilagus palustris), 360
palustris (Neosorex), 263
(Oryzomys), 309
(Oryzomys palustris), 309
(Rana), 181
(Sylvilagus), 360
panamintinus (Eutamias), 344
(Perognathus), 329
(Perodipus), 332
Panther, 294
Pantosteus, 55
papilliferus (Chologaster), 107
papillosum (Moxostoma), 60
Parascalops, 258
Parascaphirhynchus, 31
pardalis (Felis), 294
parietalis (Thamnophis sirtalis), 228
parkei (Salvelinus), 49
paroticum (Ambystoma), 152
parva (Cryptotis), 265
(Lucania), 105
parvidens (Cynomys), 350
parvipinnis (Hesperoleucus), 72
parvula (Marmota flaviventris), 351
parvulus (Sylvilagus auduboni), 359
parvus (Citellus tridecemlineatus), 347
(Dipodomys), 333
parvus (Perognathus), 330
(Perognathus parvus), 330
(Scalopus aquaticus), 258
Patch-nose snake, 216
pauperrimus (Lagurus), 318
Pecari, 362
Peccaries, 362
pectoralis laceianus (Peromyscus), 308
Pekan, 282
pellucida (Ammocrypta), 131
Pelobatidæ, 169
peltatus (Hadropterus), 125
penicillatus (Perognathus), 330
peninsulæ (Blarina brevicauda), 265
(Putorius), 284
pennanti (Mustela), 282
(Mustela pennanti), 282
pennsylvanica (Neotoma), 311
pennsylvanicus (Microtus), 316
(Microtus pennsylvanicus), 316
*pensilvanicum* (*Kinonsternon*), 238
Perca, 122
fluviatilis, 122
schrenki, 122
Percesoces, 112
Perch, 121
Percidæ, 121
Percina, 124
Percoidei, 113
Percopsidæ, 111
Percopsis, 111
Perodipus, 331
Perognathus, 328
Peromyscus, 303
perpallidus (Onychomys torridus), 301
(Thomomys), 326
(Thomomys perpallidus), 326
perpes (Thomomys perpallidus), 326
perplexus (Cnemidophorus), 205
(Perodipus), 332
personatus (Sorex), 261
petrensis (Marmota monax), 351
Petromyzon, 26
Petromyzonidæ, 25
phæonotus (Lepus americanus), 355
phea (Aplodontia), 336
Phenacobius, 85
Phenacomys, 320
phenax (Spilogale), 291
(Spilogale phenax), 291
phlegethontis (Leuciscus), 71
Phoca, 297
Phocidæ, 297
photogenis (Notropis), 83

phoxocephalus (Hadropterus), 125
Phrynosoma, 200
Phyllorhynchus, 216
Phyllostomidæ, 266
physignathus (Platygobio), 90
Pickerel, 98
frog, 181
*pickeringi* (*Hyla*), 177
picta (Chrysemys), 246
pictus (Eutamias minimus), 345
pigmæa (Umbra), 97
Pigmy sunfish, 114
pigra (Didelphis virginiana), 256
Pigs, 361
Pikas, 360
Pike, 98
Pike-perch, 123
pileata (Malaclemys), 244
(Malaclemys pileata), 244
pilsbryi (Notropis), 83
Pimephales, 67
Pine lizard, 198
marten, 281
mouse, 319
snake, 219
squirrel, 339
pinetis (Sylvilagus), 358
pinetorum (Neotoma mexicana), 312
(Pitymys), 319
(Pitymys pinetorum), 319
(Thomomys monticola), 327
Pinnipedia, 296
Pipidæ, 167
pipiens (Rana), 180
Pipistrellus, 270
Pirate perch, 113
Pisces, 27
piscivorus (Agkistrodon), 231
Pituophis, 219
Pitymys, 319
Placopharynx,, 61
Plains cayote, 276
planeri (Lampetra), 27
planiceps (Tantilla), 229
Plateau wildcat, 296
platorhynchus (Scaphirhynchus), 31
platostomus (Lepisosteus), 32
platycephalus (Ameiurus), 95
(Hydromantes), 165
Platygobio, 90
platyrhinos (Phrynosoma), 202
*platyrhinus* (*Heterodon*), 215
plebeius (Pantosteus), 55
Plestiodon, 205
Plethodon, 157
Plethodontidæ, 154
pleuriticus (Salmo), 45
plumbea (Hybognathus), 67
plumbeus (Couesius), 90
pluvialis (Plestiodon), 207
Pocket gophers, 323
mice, 328
podostemone (Boleosoma), 129
Pœciliidæ, 100
pœcilurum (Moxostoma), 61
Pogonichthys, 68
Polar bear, 273
polionotus (Peromyscus), 306
(Peromyscus polionotus), 306
Polistotrema stouti, 24
Polyodon, 29
Polyodontidæ, 29
polyphemus (Gopherus), 248
Polyprotodontia, 255
pomotis (Acantharchus), 115
Pomoxis, 115
Pomolobus, 36
Pond turtles, 239
Pontoon, 360
Porcupines, 335
porosus (Crocodylus), 190
porphyriticus (Gyrinophilus), 162
Potamophis, 227
prælaris (Microperca), 136
Prairie dogs, 349
meadow mouse, 316
rattler, 234
wolf, 276
pratensis (Citellus spilosoma), 348
preblei (Phenacomys), 320
preblorum (Marmota monax), 351
pretiosa (Rana), 184
pricei (Crotalus), 234
(Eutamias), 343
princeps (Gerrhonotus), 203
(Zapus), 334
procne (Notropis), 78
Procyon, 279
Procyonidæ, 279
prognathus (Leucichthys), 41
promelas (Pimephales), 67
Prong-horn antelope, 366
propinqua (Holbrookia), 196
Proteida, 147
Proteidæ, 147
proximus (Thamnophis), 229
Pseudacris, 178
Pseudemys, 246

Pseudobranchus, 166
pseudogeographica (Graptemys), 245
(Graptemys pseudogeographica), 245
pseudoharengus (Pomolobus), 36
Pseudotriton, 162
psora (Procyon), 280
(Procyon psora), 280
Psychromaster, 135
Ptychocheilus, 68
pulcher (Onychomys torridus), 301
(Scalopus aquaticus), 258
pulchra (Anniella), 204
(Holbrookia), 196
Puma, 294
Pumpkin-seed, 120
*punctatum* (*Ambystoma*), 150
punctatus (Bufo), 173
(Diadophis), 214
(Ictalurus), 92
(Lepomis), 118
(Necturus), 147
punctulata (Microperca), 136
punctulatum (Etheostoma), 134
punctulatus (Notropis umbratilis), 84
pungitius (Pygosteus), 111
putida (Mephitis), 288
Putorius, 283
putorius (Spilogale), 290
pygmæa (Eucalia inconstans), 111
pygæa (Seminatrix), 226
pygmæus (Thomomys), 327
Pygosteus, 111
pyromelana (Lampropeltis), 222
pyrrhomelas (Notropis), 80

quadracus (Apeltes), 111
quadramaculata (Desmognathus), 156
quadratus (Thomomys), 327
(Thomomys quadratus), 327
quadridigitata (Eurycea), 164
quadrilateralis (Coregonus), 38
quadrimaculatus (Eutamias), 343
quadrivittata (Elaphe), 218
quadrivittatus (Eutamias), 344
Queen-snake, 224
querceti (Sciuropterus volans), 352
quercicus (Bufo), 172
quiescens (Copelandellus), 136
Quillback, 54
Quinnat salmon, 43
*quinquelineatus* (*Plestiodon*), 206

Rabbits, 354
Race runners, 204
Racers, 216
Racoons, 279
radix (Thamnophis), 229
Rain-water fish, 105
Rainbow darter, 134
snake, 213
trout, 46
rainieri (Aplodontia major), 336
ramona (Onychomys torridus), 301
Rana, 179
Rangifer, 366
arcticus, 366
Ranidæ, 179
rathbuni (Fundulus), 102
(Typhlomolge), 161
Rats, 298
Rattlesnakes, 230, 232
rattus (Mus), 299
raviventris (Reithrodontomys), 303
(Reithrodontomys raviventris), 303
Razor-back, 59
Red-back mice, 320
Red-backed salamander, 158
Red bat, 271
Red-bellied dace, 66
snake, 227
terrapin, 247
Red deer, 363
fallfish, 81
foxes, 276, 277
salamander, 163
squirrel, 338
Redfin, 78, 80, 84
Redfish, 43
Redhorse, 59
Redwood squirrel, 339
Reef gecko, 193
regalis (Diadophis), 214
(Salmo), 47
(Vulpes), 277
regilla (Hyla), 178
Reithrodontomys, 301
Reptiles, 188
reticularia (Deirochelys), 248
reticulatus (Crotaphytus), 195
(Esox), 99
rex (Percina), 124
reynoldsi (Neoseps), 207
Rhineura, 208
Rhinichthys, 85
Rhinocheilus, 223
rhoadsi (Evotomys gapperi), 321
(Peromyscus polionatus), 306
rhombifera (Natrix), 226

rhombomaculata (Lampropeltis), 222
rhotheus (Cottus), 140
Rhyacotriton, 149
Ribbon snake, 228
Rice rat, 309
richardsoni (Citellus), 348
(Lepus californicus), 357
(Microtus), 318
(Perodipus montanus), 332
(Sciurus hudsonicus), 338
(Sorex), 262
ricordii (Eleutherodactylus), 174
Rifflefish, 140
rigida (Natrix), 224
rimiculus (Catostomus), 56
Ring-neck snakes, 214
Ring-tailed cat, 280
Ringed seal, 297
Rio Grande trout, 45
ripensis (Fiber zibethicus), 323
rivalicius (Fiber), 323
River chub, 90
riversiana (Xantusia), 204
rivularis (Microtus montanus), 317
rixosus (Putorius), 285
Roaches, 71
roanensis (Napœozapus insignis), 335
roanoka (Hadropterus), 126
robusta (Gila), 69
Roccus, 137
Rock bass, 116
mouse, 308
squirrels, 345
Rocky Mountain bullhead, 140
Rocky Mountain whitefish, 38
Rodentia, 298
Roof-rat, 299
roosevelti (Salmo), 47
roseipinnis (Notropis), 84
roseofusca (Lichanura), 211
roseus (Notropis), 82
*rostrata* (*Anguilla*), 51
Round sunfish, 115
Roundtail, 69
rowleyi (Peromyscus boylei), 307
Rubber snake, 211
ruber (Pseudotriton), 163
(Pseudotriton ruber), 163
rubicundus (Acipenser), 30
rubida (Neotoma floridana), 311
rubidus (Peromyscus maniculatus), 305
rubricosa (Vulpes), 277
rubricroceus (Notropis), 81
rubrifrons (Fundulus), 103
rubrifrons (Hybopsis), 89
rubrifrons (Notropis), 83
rubriventris (Pseudemys), 247
rufa (Aplodontia), 336
rufescens (Marmota monax), 351
(Thomomys talpoides), 327
ruffus (Lynx), 295
(Lynx ruffus), 295
rufilineatum (Etheostoma), 134
rafinus (Peromyscus maniculatus), 306
rufiventer (Sciurus niger), 342
rufus (Canis), 276
ruidosæ (Onychomys leucogaster), 301
Ruminantia, 362
rupestris (Ambloplites), 116
rupiscartes (Moxostoma), 60
Rutilus, 71

Sable, 281
sabrinus (Sciuropterus), 352
sackeni (Thamnophis), 229
Sacramento perch, 116
sagittalis (Geomys breviceps), 324
Saibling, 49
Salamanders, 145, 147
Salamandridæ, 152
salar (Salmo), 44
Salientia, 166
Salmo, 43
salmoides Macropterus), 121
Salmon, 43
Salmonidæ, 37
Salmoninæ, 42
Salmopercæ, 111
Salt marsh turtles, 243
Salvadora, 216
Salvelinus, 48
sanctidiegi (Sylvilagus auduboni), 359
Sand-darter, 131
Sand pike, 123
sapidissima (Alosa), 36
Sardine, 36
saturatus (Callospermophilus lateralis), 345
(Evotomys gapperi), 321
(Myotis yumanensis), 269
(Putorius), 285
(Thomomys fuscus), 328
Sauger, 123
*Sauria*, 191
sauritus (Thamnophis), 228
Sauromalus, 194
Sauropsida, 14
saxatilis (Ochotona), 361
sayanus (Aphredoderus), 113

sayi (Pituophis), 220
scalopsoides (Pitymys pinetorum), 319
Scalopus, 257
Scapanus, 259
Scaphiopus, 169
Scaphirhynchus, 31
Scarlet snake, 222
Sceloporus, 198
scepticus (Notropis), 83
schefferi (Scapanus orarius), 260
schencki (Pseudotriton ruber), 163
Schilbeodes, 95
schisticeps (Ochotona), 361
sciadicus (Fundulus), 103
Sciænidæ, 138
scierus (Hadropterus), 126
scincicauda (Gerrhonotus), 203
Scincidæ, 205
Sciuridæ, 336
Sciuropterus, 352
Sciurus, 337
*scoparia* (*Uma*), 196
Scorpion mice, 300
scotti (Urocyon cinereoargenteus), 278
scripta (Pseudemys), 247
Sculpins, 139
scutatum (Hemidactylium), 159
scylla (Notropis), 77
Sea bass, 137
Sea-lion, 296
Sea-otter, 292
Seals, 296
sebago (Salmo salar), 44
Selachii, 28
selenops (Hiodon), 35
semiannulata (Sonora), 223
Seminatrix, 226
seminola (Nycteris borealis), 271
seminolis (Fundulus), 102
semiscaber (Cottus), 140
Semotilus, 68
senex (Eutamias), 344
sennetti (Perodipus), 331
septemvittata (Natrix), 224
septentrionalis (Plestiodon), 206
(Rana), 183
sequoiensis (Urocyon californicus), 279
serena (Hybognathus), 67
sericatus (Scepanus latimanus), 260
serpens (Microtus), 318
Serpentes, 208
serpentina (Chelydra), 239
Serranidæ, 137
sexlineatus (Cnemidophorus), 204
Shad, 36
shasta (Salmo), 46
Sheep, 367
Sheephead, 138
shermani (Plethodon), 159
Shiner, 71, 74, 78, 80
Short-nosed gar, 32
sturgeon, 30
Short-tailed shrew, 264
weasel, 284
Shovel-nosed sturgeon, 31
Shrews, 260
shumardi (Cottogaster), 127
shumardi (Notropis), 78
Siagonodon, 211
sicculus (Labidesthes), 113
Sidewinder, 234
sierræ (Lepus campestris), 356
(Marmota flaviventris), 351
(Ovis canadensis), 367
(Rana boyli), 183
Sigmodon, 310
Siluridæ, 91
silus (Crotaphytus), 195
(Sciuropterus sabrinus), 353
Silver bass, 35
lamprey, 25
salmon, 43
trout, 44, 45
Silver-fin, 80
Silver grey fox, 277
Silver-haired bat, 269
Silversides, 112
similis (Sylvilagus floridanus), 358
simotera (Ulocentra), 128
simulans (Perodipus), 331
simus (Heterodon), 215
sipedon (Natrix), 225
(Natrix sipedon), 225
Siredon pisciformis, 151
Siren, 166
Sirenia, 256
Sirenidæ, 166
sirtalis (Thamnophis), 228
(Thamnophis sirtalis), 228
sisco (Leucichthys), 40
siscowet (Cristivomer), 48
Sistrurus, 231
skiltonianus (Plesdiodon), 207
Skinks, 205
Skipjack, 36
Skunks, 287
Sliders, 246
Small catfish, 93

Small-mouthed black bass, 121
buffalo, 53
smaragdus (Salmo), 47
Smelt, 40, 50
Smoky shrews, 262
Snakes, 208
Snapping turtles, 239
Snowshoe rabbit, 355
snyderi (Catostomus), 57
Soft-shell turtles, 249
solare (Phrynosoma), 201
Soleidæ, 143
Snoora, 222
sonora (Lutra canadensis), 292
sonoriense (Kinosternon), 238
sonoriensis (Peromyscus maniculatus), 306
Sorex, 261
Soricidæ, 260
Southern wolf, 275
Spadefoot toads, 169
spadicipygus (Sigmodon hispidus), 310
spadix (Putorius longicaudus), 285
sparoides (Pomoxis), 115
spathula (Polyodon), 29
speciosus (Eutamias), 344
Speckled trout, 48
spectabilis (Dipodomys), 333
spectrunculus (Notropis), 78
spelæus (Typhlotriton), 161
*Spelerpes*, 162, 163
speleus (Amblyopsis), 107
*Spermophilus*, 346
Sphærodoctylus, 193
cinereus, 193
sphagnicola (Synaptomys), 320
sphenocephala (Rana), 182
Spilogale, 290
spilosoma (Citellus), 347
*Spilotes*, 219
spilurus (Salmo), 45
spinifer (Amyda), 249
spinosus (Sceloporus), 199
Spiny swifts, 198
spissigrada (Mephitis occidentalis), 289
Split-tail, 68
Spoonbill, 29
spot-tail, 78
Spotted cat, 92
lizards, 196
salamander, 150, 153
skunks, 290
sucker, 59
sunfish, 119
turtle, 240
Spring-frog, 181
squamatus (Hypohomus), 126
squamiceps (Etheostoma), 135
Squawfish, 69
squirella (Hyla), 177
Squirrels, 336
stanleyi (Coregonus), 38
stansburiana (Uta), 197
(Uta stansburiana), 197
Star-nosed mole, 259
Steelhead trout, 45
steindachneri (Kinosternon), 238
*stejnegeri* (*Ambystoma*), 152
stejnegeri (Uta stansburiana), 197
Steller's sea-lion, 296
stellifer (Fundulus), 102
stephensi (Citellus mollis), 349
(Neotoma lepida), 312
(Perodipus), 331
(Sciuropterus alpinus), 353
Stereochilus, 161
Sticklebacks, 109
stigmæa (Ulocentra), 128
stigmaturus (Notropis), 79
stilbius (Notropis), 83
Stilosoma, 222
Stizostedion, 123
stomias (Chasmistes, 58
(Salmo), 45
Stone cat, 95
roller, 65
stonei (Salmo), 47
Storeria, 226
storerianus (Hybopsis), 89
stouti (Polistotrema), 24
streatori (Neotoma fuscipes), 313
(Perodipus), 331
(Putorius), 285
(Putorius streatori), 285
(Sciurus hudsonicus), 338
striatulus (Potamophis), 227
striatus (Tamias), 342
striatus (Pseudobranchus), 166
(Tamias), 342
(Tamias striatus), 342
Striped bass, 137
Sturgeons, 29
sturio (Acipenser), 30
struthopus (Lepus americanus), 355
subauratus (Castor canadensis), 354
subditus (Hesperoleucus), 72
subflavus (Pipistrellus), 270
(Pipistrellus subflavus),3 72 ,
subrubrum (Kinosternon) 802

subsolanus (Lynx), 296
subterraneus (Typhlichthys), 108
subulatus (Myotis), 268
sucetta (Erimyzon), 59
Sucker-mouths, 85
Suckers, 51
Suina, 361
Sunfish, 114, 118, 119
supernas (Leucichthys), 40
Surf fishes, 139
susanæ (Boleosoma), 130
suspectum (Heloderma), 204
Swamp rabbit, 360
swannanoa (Etheostoma), 133
Swift, 193, 198, 204
  fox, 277
sylvatica (Rana), 182
Sylvilagus, 357
symmetrica (Uta ornata), 198
symmetricus (Hesperoleucus), 72
  (Lepomis), 118
Synaptomys, 319
Synentognathi, 108
Syrrhophus, 174

tæniatus (Coluber), 217
Tahoe trout, 45
tahoensis (Catostomus), 56
  (Salmo), 45
Talpidæ, 257
talpoides (Blarina brevicauda), 265
  (Thomomys), 326
  (Thomomys talpoides), 327
talpoideum (Ambystoma), 150
Tamias, 342
Tantilla, 229
Taxidea, 291
taxispilota (Natrix), 226
taxus (Taxidea), 291
  (Taxidea taxus), 292
Tayassuidæ, 362
taylori (Ochotona), 361
  (Peromyscus), 309
  (Sonora), 223
Teiidæ, 204
Teleostei, 33
Teleostomi, 28
telescopus (Notropis), 83
teliotis (Nycteris borealis), 271
telmalestes (Blarina), 265
temmincki (Macrochelys), 239
Ten-spined stickleback, 111
tenellus (Sorex), 263
  (Sorex tenellus), 263
tenuis (Contia), 222
  (Spilogale), 291
  (Uranidea), 141
tereticaudus (Citellus), 348
teretulus (Phenocobius), 85
tergisus (Hiodon), 35
Terrapene, 242
Terrapin, 244
terrestris (Bufo), 172
tessellatus (Cnemidophorus), 204
Testudinata, 234
Testudinidæ, 239
Tetragonopterus, 91
tetragrammus (Plestiodon), 207
tetranemus (Hybopsis), 88
texana (Holbrookia), 196
  (Pseudemys), 248
*texanum* (*Ambystoma*), 152
texanus (Notropis), 79
  (Odocoileus), 364
  (Peromyscus leucopus), 307
  (Scalopus aquaticus), 258
Texas red wolf, 276
  white-tail, 364
texensis (Canis nebracensis), 276
  (Citellus tridecemlineatus), 347
  (Didelphis virginiana), 255
  (Gastrophryne), 184
  (Geomys), 324
  (Lynx ruffus), 295
  (Urocyon cinereoargenteus), 278
texiana (Ovis canadensis), 367
texianus (Lepus californicus), 357
  (Sciurus niger), 342
  (Sigmodon hispidus), 310
Thalarctos maritimus, 273
thalassinum (Etheostoma), 133
thalassinus (Rutilus), 72
Thaleichthys, 50
thaleichthys (Osmerus), 50
Thamnophis, 227
transitionalis (Sylvilagus), 358
Thomomys, 325
thompsoni (Carpiodes), 54
  (Triglopsis), 142
Thymallidæ, 49
Thymallus, 49
Tiger cat, 294
  salamander, 151
tigrinum (Ambystoma), 151
tigris (Crotalus), 234
Timber wolf, 275
Toads, 166, 170
toltecus (Thomomys fulvus), 326

Top minnow, 104, 105, 106
topeka (Notropis), 78
tornillo (Peromyscus leucopus), 307
torosus (Triturus), 154
torridus (Onychomys), 301
(Onychomys torridus), 301
Tortoise shell turtle, 250
townsendi (Citellus), 349
(Corynorhinus macrotis), 272
(Eutamias), 343
(Lepus campestris), 356
(Macrotus), 317
(Scapanus), 259
(Thomomys), 326
(Urocyon californicus), 279
transmontana (Columbia), 112
transmontanus (Acipenser), 31
transversa (Natrix sipedon), 226
traski (Hysterocarpus), 139
Tree frogs, 174
toads, 174
triangulum (Lampropeltis), 221
(Lampropeltis triangulum), 221
Trichechidæ, 256
Trichechus, 256
inunguis, 256
trichroistius (Notropis), 79
tricolor (Thymallus), 49
tridactylum (Amphiuma), 148
tridecemlineatus (Citellus), 347
(Citellus tridecemlineatus), 347
tridentatus (Entosphenus), 26
(Entosphenus tridentatus), 27
Triglopsis, 142
Trimorphodon, 229
trinotatus (Zapus), 334
Trionychidæ, 249
triseriata (Pseudacris), 178
tristœchus (Lepisosteus), 32
Triturus, 153
triunguis (Terrapene carolina), 243
troosti (Pseudemys), 247
*tropicus* (*Lepisosteus*), 32
Tropidoclonion, 226
*Tropidonotus*, 224
Trout, 43
perch, 111
trowbridgei (Sorex), 262
truei (Ascaphus), 168
(Peromyscus), 308
(Peromyscus truei), 308
Trunk-back, 251
tschawytscha (Oncorhynchus), 43
tsiltcoosensis (Catostomus), 58
tularensis (Onychomys torridus), 301
Tullibee, 42
tullibee (Leucichthys), 42
Turtles, 234
tuscumbia (Psychromaster), 135
tuza (Geomys), 323
(Geomys tuza), 324
Tylosurus, 108
Typhlichthys, 108
Typhlomolge, 161
Typhlotriton, 161

ubericolor (Sylvilagus bachmani), 359
uinta (Lynx), 295
(Ochotona), 361
Ulocentra, 128
Uma, 196
umatilla (Agosia), 87
Umbra, 97
umbratilis (Notropis), 84
(Notropis umbratilis), 84
Umbridæ, 97
umbrinus (Eutamias), 344
umpquæ (Ptychocheilus), 69
undulatus (Sceloporus), 198
Ungulata, 361
unicolor (Ichthyomyzon), 26
Uranidea, 141
uranidea (Cottogaster), 127
uranops (Phenacobius), 85
Urocyon, 278
*Urodela*, 145
Ursidæ, 273
Ursus, 273
middendorffi, 273
urus (Ictiobus), 53
Uta, 197
utah (Citellus grammurus), 349
utahensis (Perodipus montanus), 332

vaga (Lutra canadensis), 292
vagrans (Sorex), 262
(Sorex vagrans), 262
valeriæ (Virginia), 227
valliceps (Bufo), 173
vallicola (Microtus californicus), 317
(Sylvilagus auduboni), 359
Vampire bats, 266
Vampyrus spectrum, 267
vandoisulus (Leuciscus), 71
vandykei (Plethodon), 159
varians (Mephitis mesomelas), 289
variatum (Etheostoma), 132

variegatus (Coleonyx), 193
(Cyprinodon), 105
Varying hare, 355
velifer (Carpiodes), 54
(Myotis), 268
velox (Vulpes), 277
ventorum (Sciurus hudsonicus), 338
ventralis (Callisaurus), 195
(Ophisaurus), 203
venusta (Lucania), 105
(Neotoma albigula), 312
venustus (Hesperoleucus), 72
(Perodipus), 331
(Tamias striatus), 342
vermiculatus (Esox), 99
vernalis (Liopeltis), 216
versicolor (Hyla), 176
(Hyla versicolor), 176
Vertebrata, 1
Vesper mice, 303
*Vespertilio*, 270
Vespertilionidæ, 267
Vespertilioninæ, 267
vexillare (Boleosoma nigrum), 130
vigilax (Cliola), 74
vigilis (Xantusia), 204
vinnulus (Ammospermophilus leucurus), 346
Viperine snakes, 208, 230
virgatipes (Rana), 183
virginalis (Salmo), 45
Virginia, 227
deer, 364
virginiana (Didelphis), 255
virginianus (Lepus americanus), 355
*virginianus* (*Odocoileus*), 364
viridescens (Triturus), 153
vison (Putorius), 285
(Putorius vison), 286
vitrea (Ioa), 131
vitreum (Stizostedion), 123
vitulina (Phoca), 297
vivax (Ammocrypta pellucida), 131
volans (Sciuropterus), 352
Voles, 313
vulgaris (Ameiurus), 94
vulgivagus (Putorius vison), 287
Vulpes, 276
vulpina (Elaphe), 219

Wall-eye pike, 123
wallawalla (Lepus californicus), 357
Wapiti, 363
Warmouth, 117
warreni (Marmota flaviventris), 352
(Neotoma albigula), 312
(Sylvilagus auduboni), 359
washingtoni (Lepus), 356
(Putorius), 285
watauga (Hybopsis), 89
Water moccasin, 231
pilot, 226
snakes, 224
Waterdog, 147
Weasels, 280, 283
wehrlei (Plethodon), 159
welaka (Notropis), 77
Western chipmunks, 343
harvest mouse, 302
porcupine, 336
puma, 294
Whip snake, 217
whipplii (Etheostoma), 135
whipplii (Notropis), 80
Whistler, 352
White bass, 137
cat, 94
mullet, 60
perch, 138
rabbit, 355
salmon, 69
sturgeon, 31
White-footed mice, 303
mouse, 306
White-tailed deer, 364
jack rabbit, 356
Whitefish, 38, 68
whitei (Salmo), 47
Whitenose, 60
Wildcat, 295
wilderæ (Eurycea bislineata), 164
*wilderi* (*Entosphenus*), 27
williamsoni (Coregonus), 38
(Gasterosteus), 110
winnemana (Microsorex), 264
wislizenii (Crotaphytus), 195
Wolverine, 283
Wolves, 274
Wood-frog, 182
Wood mice, 303
rats, 310, 311
Wood-tortoises, 240
Wood-turtle, 240
Woodchucks, 350
woodhousei (Bufo), 173
woodi (Sceloporus), 200
Woodland caribou, 366
wortmani (Callospermophitus), 346

xænocephalus (Notropis), 82
xænurus (Notropis), 80
xanthogenys (Putorius), 285
(Putorius xanthogenys), 285
Xantusia, 204
Xantusiidæ, 204
Xyrauchen, 59

yakimensis (Citellus mollis), 349
yarrowi (Agosia), 87
Yellow bass, 137
belly, 118
cat, 94
Yellow-bellied woodchuck, 351
Yellow-fin, 45
yonahlossee (Plethodon), 159
yumanensis (Myotis), 269
(Myotis yumanensis), 269

Zalophus, 296
*Zamenis*, 216
Zapodidæ, 333
Zapus, 333
zebrinus (Fundulus), 102
zenithicus (Leucichthys), 41
zibethicus (Fiber), 322
(Fiber zibethicus), 322
zonale (Etheostoma), 133
zonatum (Elassoma), 114
zonatus (Notropis), 81
zonistius (Notropis), 81
zuniensis (Cynomys gunnisoni), 350

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